

Rural Electrification in India

From 'Connections for All' to 'Power for All'

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Over the past decade and a half, India has evidenced substantial investments in rural electrification. As per official estimates, 100% village electrification and over 90% household connections have been achieved. But, if this investment is to return rural development dividends, it is important to focus on the issues of affordability, sufficiency, and quality of electricity supply, especially for small consumers. Without this, there is a danger that the new rural infrastructure will fall to disuse, as had happened in states like Bihar and Uttar Pradesh after the first wave of rural electrification. Both policies and politics need to shift focus from universal connections to upgradation of quality of supply and services.

A lot has been written since the government launched the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya) for universal household electrification in September 2017 and subsequently announced the electrification of all villages in April 2018. In fact, significant progress has been made with respect to village electrification and providing electricity connections to rural households, for over a decade. During this period, rural electrification has evidenced a paradigm shift from demand-driven village electrification programmes of the 1950s to the 1990s, to small targeted household electrification drives between the 1980s and 2005. But, concerted efforts began with the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) in 2005 that aimed to provide free electricity connections to rural households below the poverty line (BPL), besides creating rural electricity infrastructure. This was followed by successive central government schemes, which were based on similar programme design. The vision behind these schemes was to provide quality, reliable, and affordable power to enable livelihood and productive activities, such that electrification catalyses development (SCOE 2018; PEO 1965). This has been the vision for electrification the world over and has been central to electrification drives in the United States, China, Thailand, Brazil and South Africa (Barnes 2007; Niaz 2010). This article takes stock of the achievements¹ of rural electrification in India till date, and discusses the next many goalposts to meet the political commitment towards reliable and affordable power for all made by various successive governments.

The state electricity boards (SEBs) set up immediately after independence had the mandate to supply electricity beyond the major cities. Rural electrification was then a by-product of electrifying towns, and villages near the grid benefited. With the advent of the green revolution, the focus of rural electrification was also to provide impetus to the use of electric pumpsets among farmers, especially in Punjab, Haryana, Maharashtra, Gujarat and the southern states. A lot of these efforts were also strengthened and sustained due to farmers' demands.

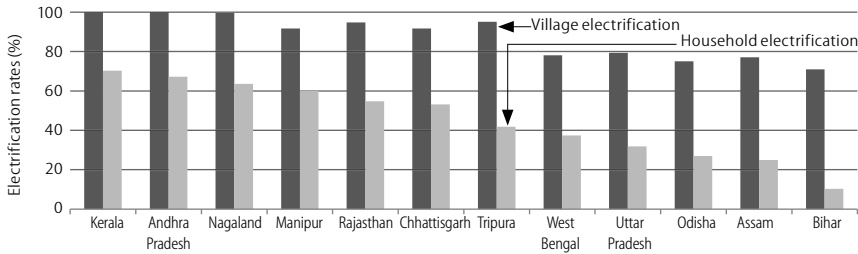
The pace of rural electrification slowed down during the power sector reforms initiated in the 1990s where the focus was on efficiency improvement and financial health of the sector. The expectation perhaps was that improvements in access to electricity will automatically follow. During this period, rural electrification departments in many SEBs were neglected or even removed, and only households close to electricity lines that could afford connection charges benefited. By 2001, as shown in Figure 1 (p 32), many states with high village electrification levels had low household access.

Recent Electrification Drives

Concerted focus on rural electrification beyond network expansion was initiated by the National Common Minimum Programme of the UPA (United Progressive Alliance) government whose main electoral agenda for coming to power was the contemporary rural distress. RGGVY, launched in 2005, was driven and financed by the central government and focused on giving free connections to BPL households. It also had provisions for capital investment in rural distribution networks. This was also the first programme to provide required funds directly to the project implementers (Distribution Companies [DISCOMs] or Central Public Sector Utilities) on a turnkey basis, instead of the state governments. Between 2005 and 2014, about 2.16 crore BPL households were provided connections under RGGVY and capital investment worth ₹33,800 crore was made to strengthen rural networks (MoP 2014). However,

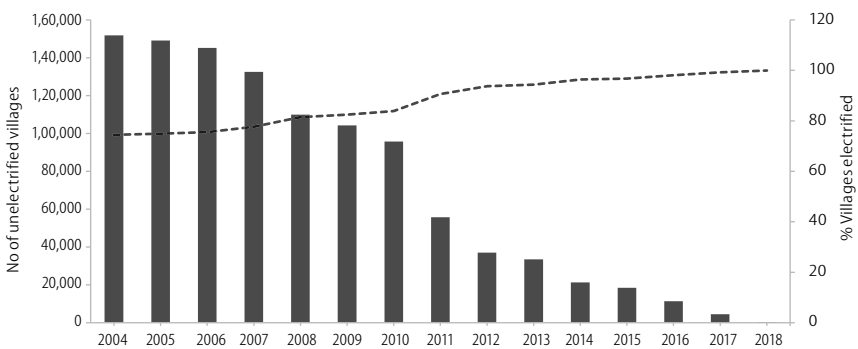
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Figure 1: States with High Village Electrification but Much Lower Household Electrification Rates in 2001



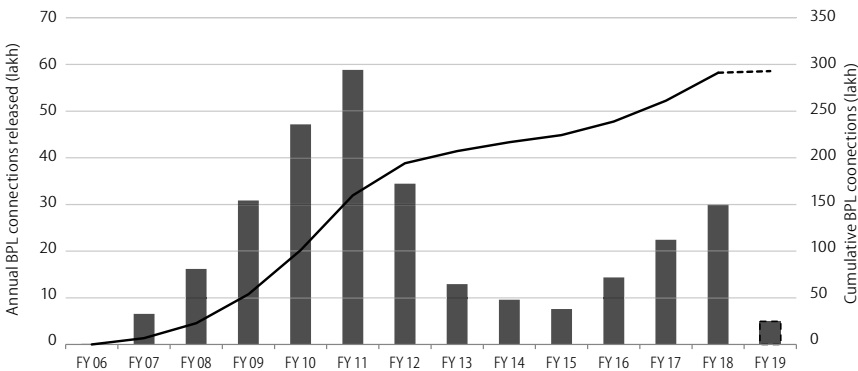
Source: Census 2001.

Figure 2: Steady Progress in Village Electrification



Source: Central Electricity Authority.

Figure 3: Progress in Release of BPL Connections since the Launch of RGGVY



Data for FY19 only for the months of April and May.
Source: REC (2014, 2016, 2017); MoP (2018a).

there were several challenges in planning, implementation and sustainability of this rural electrification programme (Dixit and Sreekumar 2011); one such being the exclusion of non-BPL households, implying that more than half of the non-electrified households were not eligible for free connections by 2011–12.

The rural electrification drive has been continuing since then, under the Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), launched in 2014. The programme had infrastructure works and connections as envisaged under RGGVY and also allocations for further investment works. Notable among them is the separation of agricultural feeders. The efforts to increase connections were also

bolstered by state-level initiatives, especially in West Bengal, Rajasthan, Chhattisgarh and Odisha which focused on electrifying habitations with less than 100 households and providing connections to households excluded under central sector electrification programmes.

Further, around the same time, the central and state governments also drafted joint plans to ensure 24 × 7 “Power for All” (PFA) by 2022. These detailed and ambitious plans included investments for capacity addition, network strengthening and electrification to provide uninterrupted power supply (Josey and Sreekumar 2015). Thus, reliable supply was seen as not only a political commitment but an attainable goal with

joint efforts by the central and the state governments.

When the Ministry of Power (MoP), in 2017, reported that 84% of rural households have electricity connections, the current government further launched the “Saubhagya” scheme to provide connections to the remaining 3.4 crore unconnected households by 2019 (MoP 2017). Unlike the previous schemes, Saubhagya aims to provide connections to all non-electrified households, whether BPL or not. While the BPL households can get free connections, non-BPL households have to pay a nominal amount of ₹500 in 10 instalments. To cover the rural households, the scheme has an outlay of ₹14,000 crore, of which 70% will come from central government grants and the rest is met through DISCOM contribution and loans (MoP 2017).

Status of Rural Electrification

Back in 2004, only six states (Kerala, Tamil Nadu, Punjab, Haryana, Gujarat, and Andhra Pradesh) claimed that more than 99% villages were electrified as per the new definition (CEA 2005). Today, almost all villages have been connected to the grid and around 4,500 villages with 1.62 lakh BPL households have been covered under off-grid schemes (MoP 2018a). It is likely that the grid will reach these villages soon, to replace or supplement off-grid power. The steady progress towards this commendable achievement is shown in Figure 2.

The progress has been not just with village electrification, but also with household electrification. With the Saubhagya scheme claiming to have already achieved 49% of its targeted 3.4 crore unconnected households by October 2018, 92% of rural households now have connections, compared to 44% in 2001 (MoP 2018b). There has been a steep rise in BPL connections since the launch of RGGVY in 2005. Figure 3 shows that the cumulative number of BPL connections (line graph) has evinced steady rise across the years. It also shows disbursement of connections, which was highest towards the end of the Eleventh Five Year Plan followed by a slump in new connections, which has been rising steadily in the recent years. This variation in connections annually

can be attributed to programme design, planning and implementation issues in the programme (PEO 2014).

In this context, it is important to highlight that while there is progress in giving connections, network investments for rural electrification have been slower than planned. Table 1 shows the cumulative achievements and funds spent under all central sector programmes since 2005.

The table clearly indicates that despite steady progress in connections, much of the works envisaged for network investment and strengthening are yet to be completed. Since 2005, over ₹1.08 lakh crore has been allocated for rural electrification, of which only 51% has been spent. This explains why only 34% of the projects have been completed, only 40% to 50% of the substations and distribution transformers (DT) planned have been installed and only 50% to 60% of the lines below 11 kV have been laid under rural electrification projects. Delays in execution are not just a legacy from the initial years of the programmes. Of the 273 DDUGJY projects sanctioned under the Twelfth Plan, almost one-third have been delayed for more than three years

(MoP 2018c). Lack of timely network investments jeopardises the provision of reliable, affordable power supply. Evaluation of rural electrification programmes also highlighted that the distribution transformers catering to villages had the capacity to support the load of only 10% of the households and thus the instances of overloading and transformer breakdowns were significant (PEO 2014; REC 2012).

Even with these issues, going by the pace of rural electrification reported by the MoP, it seems likely that India will have 100% household connections by 2022. As of June 2018, 41% of districts have more than 95% household electrification and only 5% of districts have less than 50% electrification (MoP 2018d). With further progress in rural electrification, by October 2018, 17 states—among them Gujarat, Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Tamil Nadu, Kerala, Punjab, Haryana, and Maharashtra—reported more than 99% rural household electrification. On the other hand, 88% of the remaining non-electrified households (about 8% of total households) are concentrated in only six states—Uttar Pradesh (UP), Odisha,

Rajasthan, Bihar, Jharkhand and Assam. Of this, UP alone accounts for 59%, while other states account for 4% to 8% (MoP 2018b). Concerted efforts in these states will help achieve connection goals in the near future. However, even with universal connections, several challenges will persist in the context of rural electrification which need to be addressed.

Many of these supply and service quality issues, crucial to the sustainability of electrification efforts, have also been identified in successive government-led evaluations of the rural electrification programmes. This is summarised in Table 2. Unfortunately, no major efforts have been made in successive programmes to address these issues.

As policies perceive “electrification” to be synonymous with “access to connections” alone, there have been no concerted efforts to improve the quality of supply. While the connection challenge has been nearly addressed, supply and service quality issues still persist in the sector. In fact, translating investments in connections to sustained use of electricity hinges on efforts to improve supply and service quality. It is time that we focused on policy and programme efforts at the central and state levels in this regard, especially for poor and small consumers.

Challenges of Rural Electrification

Once the connection is given, consumers have to face several challenges to retain the connection and realise the benefits of electrification. These challenges are illustrated in Figure 4 (p 34).

If supply is not affordable or the quality of supply and service is poor, it is likely that consumers will get disconnected. Poor quality of supply and service can also worsen the trust deficit between newly electrified consumers and the distribution companies (DISCOMs). This, in turn, would make programme implementation, increasing tariffs and even future metering and billing reforms challenging. Thus, if adequate attention is not given, such issues could impede the progress towards meaningful access to electricity, increase the possibility of the networks being disused or consumers resorting to power theft.

Table 1: Scope and Achievement of Recent Rural Electrification Programmes

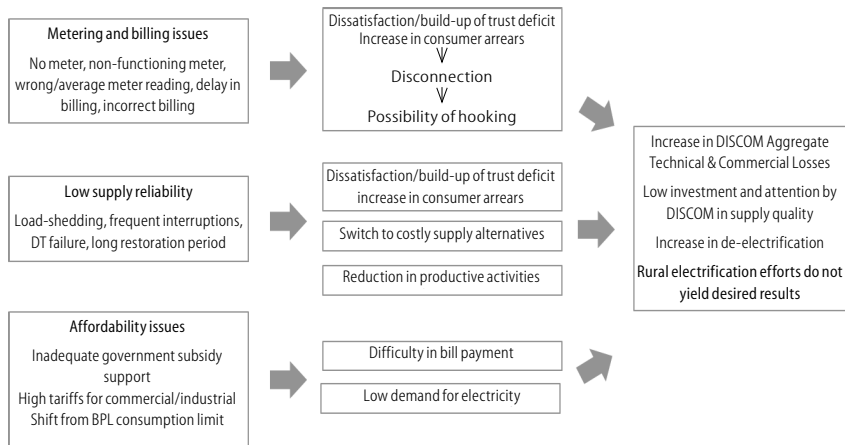
Aspect	Target	Achievement	% Achievement
Total funds (₹, crore)	1,08,682	55,214	51
Grid electrification projects (nos)	1,557	531	34
Village electrification (lakh)	1.29	1.29	100
Villages with intense electrification (lakh)	7.8	5.19	67
BPL households connection (crore)	3.9	2.96	76
Rural APL connections (Saubhagya) (crore)	2.5	0.6	24
33 kV substations (nos)	2,727	1,186	43
Distribution transformers (DT) (lakh)	1.5	0.75	50
Low tension lines (lakh circuit km)	8.62	5.46	63
11 kV feeder lines (lakh circuit km)	7.62	3.66	48

Source: Scope and achievements of rural electrification programmes as on May 2018 (MoP 2018a).

Table 2: Observations from Government-led Evaluations

Study Description	Observations
PEO study in 1982 (PEO 1982; 1965)	Billing centres, DT repair facilities > 5 km away from villages. 87% consumers faced interruptions. 93% faced voltage fluctuation which damaged motors.
Rural electrification Corporation (REC) study in 2012 (REC 2012)	Delays in billing led to arrears, disconnection. Limited electrification of public spaces. DT sizing based on 10% village electrification norm. DT under-sizing resulted in overloading and frequent DT failure.
Standing committee on energy-evaluation of RGGVY programme in 2013 (SCoE 2013)	32% of villages received < 12 hours of supply. DT undersizing sustained.
PEO evaluation of the RGGVY programme in 2014 (PEO 2014)	Arrears high due to delay in billing. 80% consumers to travel > 6 km to access billing centres. Franchisees help with bill distribution, not bill payment. Low evening supply. Minimal electrification of rural institutions. Lack of post-implementation infrastructure maintenance.
Comptroller and Auditor General evaluation of the RGGVY programme in 2014 (CAG 2014)	Unmetered connections, issues with meter installation. 32% consumers did not receive regular bills. Billing delay led to arrears. 15% consumers getting > 6–8 hours supply/day.

Source: Various evaluation reports.

Figure 4: Challenges in Ensuring Sustained Electricity Access

Source: PEG analysis.

The risk of increased losses and disconnection emphasises the need for policy-makers, regulators and the distribution company to focus on the following major components of supply and service quality which are not being adequately addressed.

Metering and billing issues: In rural areas, evidences of supply being given without proper meters/meters not being read correctly/and bills being issued without proper meter readings are commonplace.² Further, there are also instances of billing delays, particularly in issuing the first bill after connection. Consistent delays in billing increase the bill amounts through build-up of arrears, making it unaffordable for many consumers. This increases the likelihood of payment defaults leading to disconnection of supply. Once connections are given, reading the meter, issuing bills, and collecting money is the function of the distribution company. However, agencies implementing and regulating major rural electrification efforts, such as the Rural Electrification Corporation (REC), have not performed well in tracking the metering and billing status for newly electrified households even though these are crucial for retaining the connections.

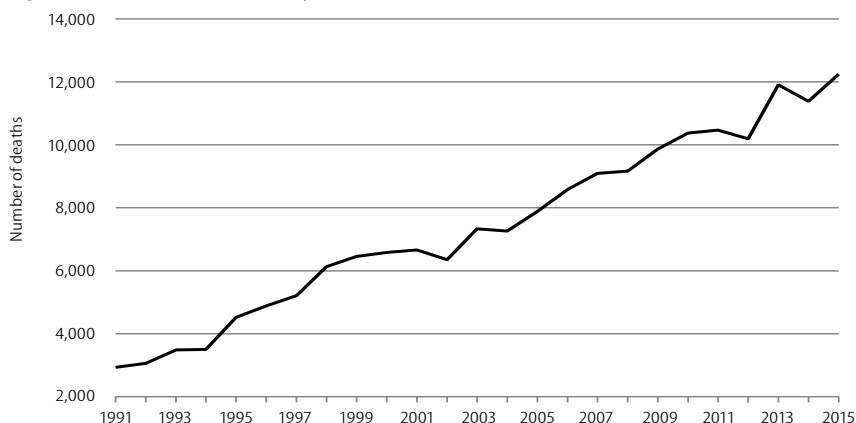
Supply outages and low hours of supply: Despite India claiming to have surplus power, many homes do not have reliable power supply. A majority of households consume less than 50 units per month, enough to cater to the basic minimum electrical needs (PEG 2017a). While the MoP reports 12–16 hours of

supply in rural areas, the monitoring devices installed by Prayas at multiple rural consumer locations indicate about three to four interruptions/day with power outages for 30%–40% of the time. Further, only 7%–10% rural locations receive supply during the full evening hours (5 pm to 11 pm) (PEG 2018a; MoP 2018a). The National Power Portal Dashboard provides data on average hours of supply for over 10,000 rural feeders which is a significant step towards greater transparency and accountability for quality of supply (MoP 2018e). However, the accuracy and reliability of this data needs to be established.³ Since the tariff for small, rural domestic households is low and the cost of supply high, distribution companies lose ₹4–₹5 for every unit supplied. Hence, there is a tendency to restrict the hours of supply (PEG 2017b). This in-built disincentive to supply needs to be addressed with concerted efforts to monitor supply hours for rural, remote and newly electrified households. Further, the rural distribution networks require investments to tide over the operation and maintenance challenges that lead to frequent failures of DTs and line faults, requiring long repair times. There is a need to hold DISCOMs accountable for monitoring of supply quality and operation and maintenance efforts in rural areas in order to ensure uninterrupted supply.

Lack of affordable power: Many regulatory commissions provide concessionary tariffs to consumers who are identified as BPL. But, poor consumers if not identified as BPL are excluded from this benefit.

In other states, consumers using less than a pre-identified number of units per month are eligible for concessionary tariffs. Thus, households using less than 30–50 units per month typically pay about ₹3 per unit when the supply cost is about ₹7 per unit. In these states, once such consumers exceed 30–50 units of consumption in any month, they are ineligible for the concessionary tariff and face significant tariff shock. Making an annual consumption limit, as done in some states, will address this issue. Beyond households, newly electrified enterprises and small establishments can also find tariffs unaffordable. In many states, small industrial and commercial consumers pay tariff rates comparable to large industrial units and commercial complexes (PEG 2018b). There needs to be innovation in tariff design to encourage home-based or small enterprises in newly electrified villages. In the future, the question of affordability of power for smaller and rural consumers will be crucial, with large industrial consumers who were cross-subsidising the consumption of small consumers increasingly meeting their needs through alternate options like open access or captive generation rather than the DISCOM. The consequent loss of revenue will further deteriorate the financial health of DISCOMs and reduce the existing support to the small consumers.

Electrification of rural enterprises and institutions: It was hoped in vain that with electrification, supplementary efforts to bolster non-residential connections and demand in rural areas would take place. Beyond the issues of affordability and supply outages, which discourage the expansion and proliferation of enterprises, it is not even clear if the networks have the capacity to support non-household uses. Evaluation reports of RGGVY indicate that the distribution transformers in the villages can support only a certain number of household demand and connections. Thus, electrification of rural enterprises does not appear to be a planned drive. This issue has not been addressed under the DDUGJY as well. Non-household activities need not be limited to enterprises only, but also

Figure 5: Increase in Fatal Electricity-related Accidents

Source: PEG analysis of National Crime Records Bureau reports from various years.

encompass schools, primary health centres, anganwadis, police stations, post offices and other village-level institutions. Electrification of these centres, let alone the quality of supply to them, is not tracked in a systematic manner.

Safety concerns with growing connections: Accidents arising from electricity shocks and fires due to electricity short-circuits have been steadily increasing over the years and reports indicate that most of these accidents happen in rural areas. Figure 5 shows the alarming trend in the increase of fatal human electricity accidents from 1991.

Poor construction and maintenance of rural distribution network is an important reason for these accidents. One shudders to think of the further increase of such accidents with the extensive spread of rural network and the increase in rural consumers.

Managing growing rural consumer base: In the first phase of RGGVY, rural franchisees were expected to manage distribution operations in newly electrified areas. However, most of them are not operational and DDUGJY does not envisage such franchisees. Bihar and Odisha have appointed franchisees in rural circles to ensure proper metering, billing and investments but their success in this regard is unclear. It is also not clear how DISCOMs will operate and maintain the significant rural infrastructure, especially as investments will be needed with increase in consumption and enhancement of supply quality.

Way Forward

Around ₹55,000 crore have been invested over the last 15 years in rural electrification. For this to return development dividends, rural electrification drives should look beyond “100% village electrification” and “100% household connections” benchmarks, to sustainable service delivery. If urgent measures are not taken, there is a danger that new consumers will be disconnected and the rural infrastructure fall to disuse—as had happened in states like Bihar and UP after the first wave of rural electrification. In this context, some suggestions are given below.

Periodic tracking of newly electrified households and villages: Parameters such as DT failure rate, hours of supply (especially during evening hours), metering and billing information (time taken to issue first bills, delay in subsequent bills, number of instances of average billing and zero billing, rate of bill payment), information on consumer disconnections, new connections for entrepreneurial use, electrification of rural institutions, could be tracked and reported on the national dashboards on a monthly basis for every district or division. There can also be periodic state-level and third-party evaluations of the programme based on this information. Such transparent and periodic tracking would go a long way in holding DISCOMs accountable for service.

Harnessing technology to monitor hours of supply: There are many capital

investment schemes under way for metering feeders and DTs, in various states. State electricity regulators can mandate DISCOMs to make this metering interface fully automatic and to make the data publicly available. Thus, the duration of supply and interruptions can be recorded without manual intervention and tracked at a disaggregated level. This information can be used by SERCS and consumers to make DISCOMs more accountable for power supply. In addition, independent monitoring of supply reliability, as demonstrated by efforts such as the Electricity Supply Monitoring Initiative (which monitors consumer level supply across locations in 22 states) can play a crucial role in making supply data publicly accessible and should be encouraged.

Holding DISCOMs accountable for the quality of rural electricity supply: The financial health and operational efficiency of DISCOMs is subject to tremendous scrutiny and attention, especially with the tariff determination processes and the performance evaluation processes under bailout schemes like UDAY (Ujwal DISCOM Assurance Yojana). There needs to be similar emphasis and political discourse on supply and service quality issues to hold DISCOMs accountable for the same. Some suggestions in this regard are:

- (i) Disbursal of rural electrification funds can also be subject to improvements in select supply quality parameters and not just based on capitalisation related project milestones. Thus, the sustainability of past investments should be considered during future grants disbursal.
- (ii) MoP can prepare annual reports analysing progress and ranking of DISCOMs for rural electrification and rural quality of supply.
- (iii) Electricity Regulatory Commissions can hold public reviews to hold DISCOMs accountable for rural electrification efforts and supply and service quality in a process similar to that of tariff determination.
- (iv) District Electricity Committees (DECs) are to be set up to monitor progress of electrification works. DECs have the senior most member of Parliament of a district as the chairperson and collector as the convenor and could be used to periodically monitor supply quality as well.

(v) Ground pressure is needed to ensure that DISCOMs work to provide quality rural supply. Civil society groups and political parties can play a role in demanding this. Civil society groups can also take up independent studies on the quality of supply and service of newly electrified areas, using surveys, RTI (right to information) queries and public hearings.

Subsidy and tariff reforms: Currently, supply of one unit of power costs the DISCOMs about ₹7 and this cost will most likely increase at a rate of more than 4% per unit in the coming years (PEG 2018b). As such costs will be unaffordable for many consumers, and with the contribution of cross-subsidies reducing, substantial subsidy support will be necessary. Supplementary efforts to provide support and rationalise tariff design are suggested below:

(i) Need to explore options for providing low-cost power for rural supply such as allocation of low-cost captive coal blocks for rural households, provision of surplus power at concessional rates or the allocation of cheaper, depreciated plants.

(ii) Megawatt scale solar plant to supply daytime, low-cost, power to an entire feeder with many agricultural consumers can be explored. Maharashtra is already contracting more than 1,700 MW

of feeder-level projects to cater to farmers in 280 talukas in a similar arrangement (MERC 2018; Prateek 2018).

(iii) Design BPL tariffs such that the consumption limit is annual and not monthly to provide flexibility. Additionally, the monthly consumption limit can also be increased. The MoP recently proposed that this could be 60 units/month (MoP 2018f).

(iv) Introduction of a general category where domestic, commercial and industrial consumers have the same telescopic tariffs for the first 300 units of consumption can support small enterprises and also reduce the harassment faced by home-based enterprises. This tariff design is currently being implemented in Maharashtra⁴ and the MoP has floated a similar proposal (MERC 2016: 431; MoP 2018g).

Pilot projects: Several ideas like prepaid metering and direct benefit transfer (DBT) are being proposed to handle the metering, billing and subsidy issues (MoP 2018f). Considering the limited financial and IT literacy of rural consumers, as well as the challenges in internet reliability, it is better to try out pilots before rolling out such solutions on a large scale. Institutional mechanisms to operate and maintain rural distribution

also require innovative thinking and options such as circle/village level franchisees, electricity cooperatives (Richmond and Patwardhan 2018). Besides, ways to strengthen rural DISCOM departments need to be explored.

Central agency to coordinate and monitor rural electrification efforts:

REC has always been the nodal agency for central sector rural electrification projects, but today its disbursements are highest in generation and transmission sectors. Its shareholding pattern has also changed over the years and now government ownership is at 58% and foreign portfolio investment is 23%. It seems that its financing decisions are guided by better and faster returns rather than social investments like rural electrification. Even after the targets of connections are met, there is a need for a national institution, with rural electrification as its key focus. Its mandate need not be to operate the rural distribution businesses but to provide knowledge and financial support to DISCOMs for maintaining and strengthening the rural network and ensuring supply.

Central government can continue to play an important role in this, especially by tracking progress and sustainability of electrification. But it is important that

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different states evolve appropriate plans to sustain efforts. There is also a need for long-term political attention and resource allocation. This should involve a transparent participatory approach with maximum inputs from the newly electrified community.

NOTES

- 1 For the analysis in this article, the authors have largely depended on publicly available sources of data. The data available on central sector schemes is mostly limited to electricity connections and the physical and financial progress as per project plans reported by project implementation agencies. There is limited, consistent information especially with respect to reliability of supply, metering and billing issues.
- 2 There is evidence of metering and billing issues even in urban areas. For example, in 2011, the Madhya Pradesh Electricity Regulatory Commission noted that there are increasing instances of incorrect billing in cities of Bhopal and Ujjain (MPERC 2011a 2011b) and an increasing trend in defective and non-functioning meters across the state (MPERC 2018). In Rajasthan, the distribution companies reported that 8%–9% of domestic consumers have defective meters (RERC 2015). Even in mostly electrified states such as Andhra Pradesh and Maharashtra, consumers have regularly presented evidence before the regulatory commissions of rising number of defective meters, delay in meter readings and billing (MERC 2016; APERC 2016).
- 3 For example, the total duration of interruptions reported (in seconds) annually for Pune, Hyderabad and Lucknow is much more than the number of seconds in a year. The same data set also shows a counter-intuitive result of smaller towns in backward districts having less interruptions and lower total duration of interruptions than the large cities in the state (PEG 2018b).
- 4 In Maharashtra, consumers undertaking business enterprises from their homes, whose monthly consumption is <300 units and annual consumption <3,600 units will be charged the same tariffs as domestic consumer tariff slabs. If consumption is >3,600 units in the previous year, the consumer is not eligible for these tariffs.

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