

Electricity Distribution Companies in India: Preparing for an Uncertain Future



Electricity Distribution Companies in India: Preparing for an uncertain future

Discussion Paper by Prayas (Energy Group), Pune

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About Prayas

Prayas (Initiatives in Health, Energy, Learning and Parenthood) is a non-profit organisation based in Pune, India. Members of Prayas are professionals working to protect and promote the public interest in general, and interests of the disadvantaged sections of society, in particular. Prayas (Energy Group) works on theoretical, conceptual, regulatory and policy issues in the energy and electricity sectors. Our activities cover research and intervention in policy and regulatory areas, as well as training, awareness, and support to civil society groups. Prayas (Energy Group) has contributed to the development of energy sector policy as part of several official committees constituted by ministries, the erstwhile Planning Commission and NITI Ayog and advisory committee of many regulatory commissions. Prayas is registered as a SIRO (Scientific and Industrial Research Organisation) with the Department of Scientific and Industrial Research, Ministry of Science and Technology, Government of India.

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Executive summary

Considered the weakest link of India's power sector, the distribution segment has been battling various challenges such as controlling aggregate technical and commercial (AT&C) losses, ensuring financial viability, providing electricity access to all households and reducing inefficiencies in power generation and planning. Recent phenomena such as significant surplus baseload capacity in many states (resulting in huge burden of fixed charges), around 40 GW of stranded generation assets, rapid reduction in prices of renewables (solar PV and wind) along with similar reduction being witnessed in battery storage systems are posing newer challenges for the typical distribution company's (DISCOM's) business model.

DISCOMs average cost of supply is increasing, which makes alternative non-DISCOM supply options such as solar and wind economically attractive for large consumers, at least to significantly reduce their energy drawal from the DISCOM. As such, sales migration through open access and captive routes is no longer merely an emerging trend, but a reality for most DISCOMs. It is increasing despite procedural hurdles, high cross-subsidy surcharge, and the imposition of additional surcharges. This is resulting in a significant loss in cross-subsidising revenue. In addition, open access, which is mostly short term, makes planning for power procurement more challenging for DISCOMs. With the rising cost of supply by DISCOMs and the falling cost of renewable energy sources, this trend is likely to intensify. For DISCOMs this means significant uncertainty about future demand and possibly the end of the cross-subsidy based business model.

This emerging scenario is likely to have two serious implications for the DISCOM's future: 1) planning for power purchase, which has always been a weakness in the DISCOM's business model, is likely to become even riskier and more complex, and 2) the loss of cross-subsidising consumers which would force DISCOMs to increase the tariff for small, rural, and agricultural consumers, which, in turn, would increase the need for direct revenue subsidy by state governments. If not managed appropriately, these factors can lead to severe financial stress, not just for the DISCOMs but also for the sector at large. This may reflect in tariff shocks, poor supply quality for small consumers, huge stranded assets, and greater need for repeated and larger bailouts, with associated implications for banking sector. Naturally, such a fallout would also have serious political implications.

Even with the best efforts and ambitious targets for efficiency improvement, annual growth in the average cost of supply of DISCOMs can at best be reduced from 5%–6% to 2%–3%, but the costs would still continue to rise. As against this, the cost of other supply options, especially solar and wind has reduced significantly. Such reduction took place due to a combination of global developments and competitive procurement strategies adopted in India. Hence, although efficiency improvements are necessary and desirable, they may not be sufficient for mitigating the adverse impacts of the impending changes in the sector. Traditional methods to stall open access by tweaking tariff design will also be ineffective. Already in many states strategies such as increasing the revenue from fixed charges while keeping tariffs the same or reducing energy charges, increasing time-of-day rebates to encourage off-peak consumption, and reducing tariffs for HT consumers through subsidies or rebates, are unable to curtail sales migration.

Thus, the traditional model of managing the distribution sector in India is on the verge of collapse. Crucially, it is not just the fate of DISCOMs that is at stake—as electrification accelerates and millions of newly electrified households join the grid, also at stake is the fate of all the small, rural, and agricultural consumers. How we manage the DISCOM's transition to the future will determine their fate. Although the emerging trends are likely to add to the uncertainty and financial troubles of already stressed DISCOMs, these disruptive forces can also be seen as an opportunity to fundamentally reform the distribution sector. This paper offers some ideas to achieve this objective of turning the impending transition into an opportunity to bring in desirable changes and to make the inevitable transition more orderly and equitable.

The suggested approach is to transform the role of DISCOMs to:

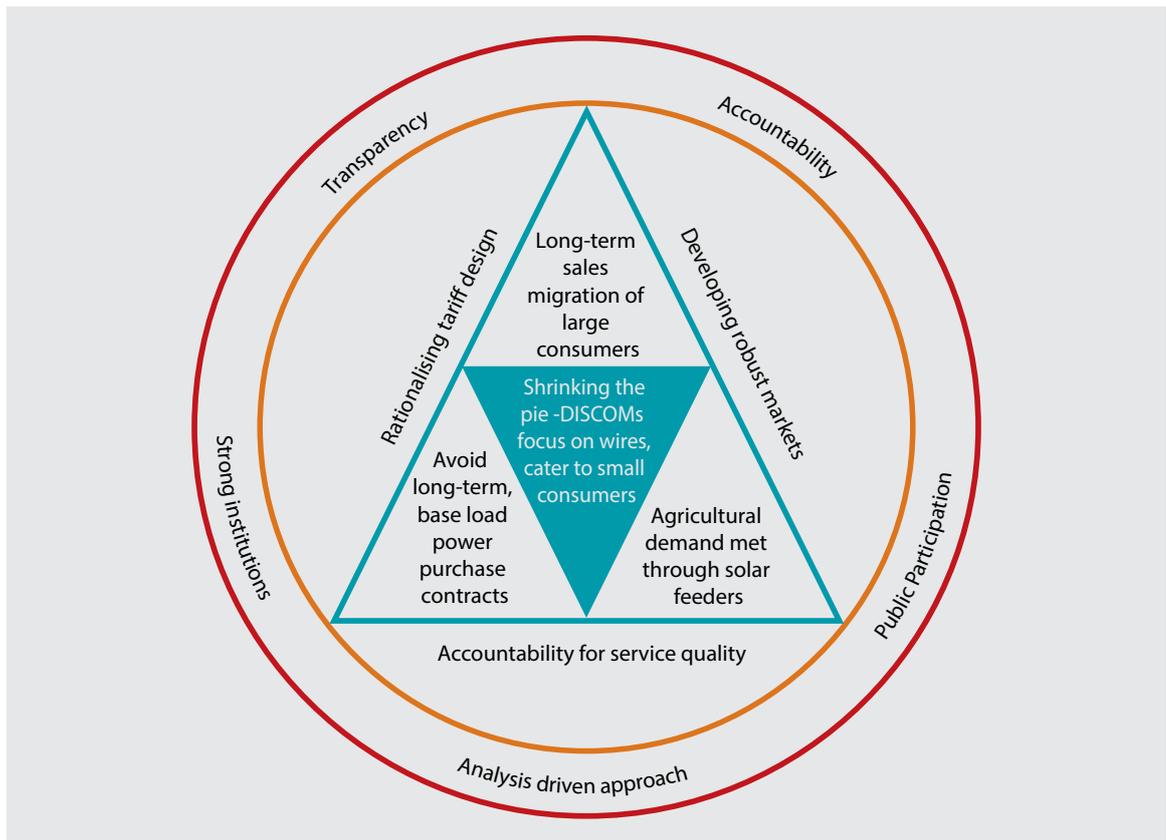
- wires licensee and provider of grid services (e.g. balancing),
- primary supplier for small and agricultural consumers, and
- the supplier of last resort for all large consumers.

This can be achieved by three strategies of

1. **Ensuring long term sales migration:** Encourage and gradually mandate large consumers (say above 50 kW load) to move towards long term, permanent open access or captive generation, and thereby make such consumers responsible for both risks and rewards of market based power procurement. Such long term sales migration would reduce demand uncertainty for DISCOMs and would also aid market development.
2. **New PPAs for baseload capacity to be avoided:** Without a rigorous, scientific analysis that considers demand uncertainty, all supply options, different instruments such as short term contracts, peaking supply contracts, and purchase from exchanges, DISCOMs should not be allowed to sign any new PPA for long-term baseload capacity. This exercise should also include a truly transparent public process. This would also ensure that the new capacity addition is considered only after existing and under construction capacity, at the national level, is utilised to the fullest extent.
3. **Solar feeders for agricultural supply:** With tariff of MW scale solar PV plants at around Rs. 3 /kWh, deployment of such plants at the substation can provide farmers day time supply while also reducing subsidy requirement. Such an approach is imminently possible with more and more states separating their agricultural feeders.

To enable these strategies, several facilitating policy, regulatory and analytical measures would be required. For example, in order to ensure long term sales migration by large consumers, there should be certainty, for at least 5 years, in charges such as cross-subsidy charge and additional surcharge, removal of procedural hurdles to enable migration and development of electricity market with long term as well as flexible instruments. Rigorous analysis based on power sector modelling tools would be required to truly assess the nature of additional supply contracts and the capacity addition required by DISCOMs under rapidly evolving scenarios in terms of demand patterns, changing technologies and their costs, national commitments about renewable energy etc. Along with this, measures to ensure equitable tariffs, efficiency improvements of the DISCOMs and monitoring of supply quality are essential to ensure affordable, reliable power for small consumers. The paper discusses some of these measures in greater detail. Needless to say, for any effective transition, efforts to ensure strong but accountable institutions and transparent and participative processes are imperative. This is represented schematically in the figure below.

Schematic representation of suggested approach



Source: Prayas (Energy Group).

The three strategies outlined above, namely 1) moving to long-term open access, 2) avoiding signing new baseload capacity PPAs, and 3) solarizing agricultural feeders, together would enable DISCOMs to avoid risks of stranded assets, suboptimal use of capacity, and increasing costs. This would enable DISCOMs to focus on the 'wires' business and evolve to assume the role of the supplier of last resort (which will be based on market principles for non-DISCOM consumers) and that of a supplier to non-contestable, small, and rural consumers (which will be largely based on existing contracted capacity). This can be seen as a nimble and flexible approach to managing an uncertain future.

Unless guided by conscious policy decisions, the impending transition will unfold chaotically, leaving the DISCOMs stranded with excess capacity and huge losses—and the sufferers of such a fallout will be mostly small and rural consumers with serious implications for state level politics. To avoid such consequences, it is extremely important to intervene now and to guide the inevitable transition in a manner that enables DISCOMs to adapt to the fast-changing realities of the sector. The impending changes can be turned into opportunities only if DISCOMs, regulators, and policymakers begin acting at the earliest. These approaches suggested in this paper may need to be spelt out in greater detail and improved upon after further deliberations, but unless the issues and trends discussed here are addressed in a proactive and coordinated manner, the uncertain future – and the transition to it – will be far more painful.

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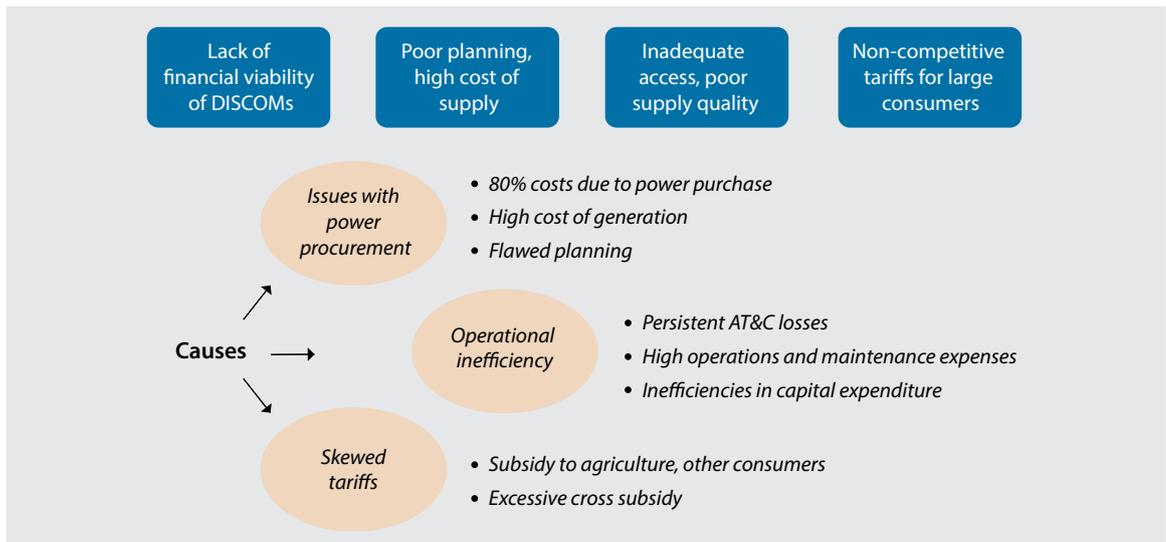
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1. Introduction and Context

Distribution is the power sector's direct interface with the public. All the costs incurred in supplying power, including generation, transmission, and distribution, are recovered from the retail tariffs charged by the distribution company (henceforth referred to as DISCOM) to its customers. Governments, state and central, subsidise the tariffs for some consumer categories or end uses, such as households below the poverty line (BPL households) or pump sets for irrigation and also provide subsidies or grants to DISCOMs for capital expenditure on some projects, e.g. infrastructure development for rural electrification.

Considered the Achilles' heel of India's power sector, the distribution segment has been battling various challenges such as controlling aggregate technical and commercial (AT&C) losses, ensuring financial viability, providing electricity access to all households, and improving supply and service quality. Interlinked with these challenges are the issues of tariffs that are not reflective of costs, subsidy payments that are delayed or inadequate, and inefficiencies in power generation and planning leading to suboptimal and often unsustainable generation costs. Figure 1 captures these age-old challenges faced by DISCOMs along with factors responsible for the challenges.

Figure 1: Chronic problems faced by DISCOMs



Source: Prayas (Energy Group).

In the past two decades, a number of attempts have been made to surmount these challenges faced by the distribution sector. Such attempts include legal and regulatory reforms under the Electricity Regulatory Commissions Act, 1998, and the Electricity Act, 2003 (henceforth referred as '(E Act) 2003'), which paved the way for competition and altered the industry structure and governance framework. The (E Act) 2003 de-licensed generation and enabled rapid capacity addition through private sector participation. To revive the financially stressed distribution sector, the central government from time to time has initiated bail-out packages such as the Financial Restructuring Plan (FRP) in 2012-13 and, more recently, the Ujwal DISCOM Assurance Yojana (UDAY) in 2015-16. Further, government schemes such as the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), Restructured Accelerated Power Development and Reforms Programme (R-APDRP), and Integrated Power Development Scheme (IPDS), aimed at increasing the number of connections and strengthening the distribution network, have been undertaken.

Although these multiple and varied efforts have had limited success in overcoming the chronic problems faced by DISCOMs, the efforts led to two important outcomes:

1. massive expansion of the distribution network, which is expected to connect almost all households to the grid in near future, and
2. huge increase in installed capacity because of which many states at present are experiencing significant surplus baseload power.

The presence of baseload surplus power along with political commitment to providing 24 × 7 power for all creates hope and the possibility of achieving the goal of universal access to electricity. However, there remain many challenges in providing access that results in reliable and affordable supply to all, especially to small and rural consumers. One major bottleneck to such access is the precarious financial health of the DISCOMs that are responsible for ensuring the supply. Unfortunately, although significant progress has been made in terms of access and capacity addition, several other problems that continue to plague the distribution sector, especially those related to governance, are yet to be addressed. Thus, the dual challenge of ensuring financial sustainability of DISCOMs and at the same time providing affordable, competitively priced, and good-quality 24 x 7 supply to all has become even more complex and arduous.

On the generation side, more than 40 GW, i.e. about 15% of the installed conventional power capacity of utilities, are classified as stressed assets (Standing Committee on Energy 2017–18, 2018, p. 18). This is because of a combination of factors such as lack of demand from the concerned DISCOMs, very high cost of power, inadequate or poor-quality fuel, and unwillingness of generators to supply at contracted rates. This underscores the importance of careful capacity addition planning. In FY 2015–16, in states such as Gujarat, Madhya Pradesh, Maharashtra, Punjab, and Rajasthan, about 15%–30% of the capacity contracted by DISCOMs was idle or unutilised. The burden of such excess capacity in terms of fixed costs alone is Rs. 1000–3000 crore per state annually, which is more than half the annual financial subsidy provided to these DISCOMs by the respective state governments (PEG, 2017). Such huge excess capacity and stranded assets impose a significant financial burden on both DISCOMs and the banking sector. In addition, the government has set a high target of 175 GW installed renewable energy capacity (mostly solar and wind power) by 2022. This will make grid planning and operations even more complex.

In the future, social and local environmental factors and considerations related to climate change are expected to play an increasingly important role in shaping the sector's policy and rightly so. Similarly, along with a push for renewable energy, one should expect a stronger push for energy efficiency and significant energy savings from it. New applications, such as e-vehicles and mobility-as-a-service (MaaS) business models are being promoted aggressively and are gaining ground rapidly.¹

Alongside these developments, there have been dramatic changes in costs and tariffs of renewable energy. The tariff for solar PV for megawatt-scale plants has fallen drastically, and a fixed levelised tariff of around Rs. 3/kWh for 25 years is no longer considered aggressive. For wind, a tariff below Rs. 3/kWh is increasingly becoming the norm (PEG, 2018). The cost of battery based storage, especially, lithium ion batteries, is also falling rapidly. Between 2010 and 2016, the cost fell by more than 70% (McKinsey & Co., 2017), and market surveys show a 24% reduction in price between 2016 and 2017 (BNEF, 2017). The current cost of a battery pack is about US\$ 250/kWh and is expected to drop further, although the pace and the scale of such a drop remain uncertain.²

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1. NITI Aayog in a recent report based on stakeholder consultation has outlined a plan up to 2032 for system integration, development of shared infrastructure, and scaling up of manufacturing capacity in the electric vehicles segment to enable India's electric mobility transformation (NITI Aayog, 2017).
 2. Estimates released in January 2017, when the price was \$ 273/kWh, project the price to go to \$190/kWh by 2020 and to be less than \$100/kWh by 2030 (McKinsey & Co., 2017). A December 2017 estimate projects the 2025 prices for a lithium-ion battery pack at below \$100/kWh (BNEF, 2017). The same agency estimates the current learning rate for lithium-ion storage systems (price reduction per doubling of capacity) at 19% (BNEF, 2017). This is comparable to the learning rate for solar PV systems between 1990 and 2013 (Fraunhofer ISE, 2015) and is also comparable to the learning rate for DRAM semiconductors between 1974 and 1992 (Irwin & Klenow, 1994).

Reduction in the costs of renewable energy and energy storage and improvements in technology are driven by global developments. In the light of India's commitment to increasing the use of renewable sources, domestic policy and regulatory approaches are less likely to be a hurdle in taking advantage of these global changes.

All these changes are shaking the fundamental pillars of electricity supply industry in the following ways.

- **Cost of marginal capacity addition is likely to be less than the average cost of contracted capacity.** For many DISCOMs, the average cost of power purchase is above Rs. 3/kWh and it is increasing every year because of high capital costs and rising variable costs of new thermal plants. The tariff of thermal generation capacity added in the last five years is in the range of Rs. 4–5/kWh. However, new solar and wind capacity is available at less than Rs. 3/kWh, with tariff remaining fixed for the next 25 years. Being a variable source of energy, procuring renewable energy (especially wind and solar) potentially entails higher system-integration costs (especially for balancing), which need to be factored in for comparing its price with that of any baseload capacity.³ Although only a few studies have been undertaken to examine this aspect in India, one such study by the Central Electricity Authority (CEA) found that "even after including the financial implication on account of variable renewable generation, it would still be cheaper in the future to set up renewable generation capacity, as compared to coal-based capacity" (CEA, 2017, p. 2). Thus, in terms of energy cost, capacity addition in the future is likely to be less expensive than the long-term capacity currently contracted⁴ by the DISCOMs.
- **Generation projects no longer require long gestation periods and are modular.** Unlike conventional power projects, solar and wind projects can be commissioned in less than two years. Solar is also highly modular, with even 1 MW capacity offering a reasonable economy of scale and a competitive generation cost. This change would ease capital requirements and encourage investments and competition in the generation business.
- **Electricity can be stored with increasing ease and affordability.** Large-scale storage of electricity is no more a utopian concept, and will become increasingly practical and economical through various avenues. Significant investments from across the globe, increased production capacity, competitive supply chains, and improvements in current technology are expected to contribute to the price drop.
- **Grid services are likely to be as critical as supply.** With increasing share of weather-dependent renewable generation sources and millions of 'prosumers' and decentralised generators connected to the grid, the role, importance, and cost of maintaining grid security and providing grid services will increase significantly. Smart meters coupled with smart appliances and other such 'behind the meter' technologies would lead to innovative measures for load shaping and demand-side management (DSM). Due to these factors and increase in system complexity, in the next few years the role of managing wires is likely to become as critical as, if not more than, that of providing electricity.

3. Estimating and attributing any renewable-energy-specific integration costs is not an easy exercise, especially for the relatively weaker Indian grid, which is seeing several grid-strengthening initiatives that are under way for effective, reliable, and secure grid operation. Factors such as the existing generation mix and its flexibility, load profiles with their daily and seasonal variations, transmission network and locations of upcoming power plants, penetration level of renewable energy, existing operational practices, grid code rules, and the current poor supply reliability would need to be critically considered while determining such system integration costs. Also, while estimating such costs, it is important to have same assumptions for grid reliability and functioning for a system with and without renewables.

4. The cost of new thermal power, which is currently in the range of Rs. 4–5/kWh, is bound to increase on account of factors such as compliance with environmental norms, and is subject to volatility in fuel prices. It is worth noting that the cost of the externalities imposed by thermal generation is not adequately accounted for and if it were to be fully factored in, the cost of thermal generation would be even higher than what is currently assumed.

Against this backdrop, what are the implications of these developments for the medium- and long-term future of the distribution sector, especially the DISCOMs? What aspects of the traditional approach to managing the distribution sector in India need to be fundamentally altered to meet the challenges posed by this future? In short, how to prepare the distribution sector for the uncertain future?

These questions need to be thoroughly and urgently discussed by all stakeholders to develop an appropriate policy and regulatory response. To fail to undertake in-depth, multi-dimensional analysis and co-ordinated actions on these issues is to risk creating huge stranded assets, necessitating potentially a much larger bail-out package than any earlier one and, more importantly, losing crucial opportunities to ensure that the electricity distribution sector contributes to, rather than hinders, economic and social development.

This paper is an effort to contribute to this process and presents analysis to highlight emerging trends and to assess their likely impacts on DISCOMs. In the light of the impending changes, the paper also offers a few policy approaches, which can help in better preparing the DISCOMs to navigate the uncertain future and to minimise the risks and costs arising from it. The discussion is more focused on medium- and long-term issues (i.e 5 year plus horizon) and hence does not get into the immediate challenges of the sector, such as the present accumulated financial losses of DISCOMs, the existing stranded and/or non-performing assets in the generation sector, and last-mile connectivity to ensure universal access to electricity, for which several schemes are already being implemented. Also, the paper does not delve into topics such as the integration of renewable energy with the grid, grid management, distribution infrastructure necessary for enabling a massive shift to electric vehicles, and energy accounting and metering. These are no doubt important issues, but the objective of this paper is to take a step back and think about the future without getting overwhelmed by these immediate and short-term issues. Issues such as privatization and the efficacy of regulatory process, which are also crucial to the health of the sector, are also beyond the scope of this paper.

2. Emerging Trends and their Implications

To understand how the emerging trends are likely to impact DISCOMs, it is essential to first understand the current distribution set-up and how it functions. Traditionally, a DISCOM has had two functions, namely maintaining the network (the wires business) and procuring power to ensure supply (the supply business). For the last few decades, in most states, it was safe to assume that the DISCOM's demand represented the demand of that state. Through these years, an era of chronic shortages, the DISCOMs followed a supply-oriented approach to planning (Reddy, 1990, p. 2); planning for power purchase was thus synonymous to adding baseload capacity through long-term power purchase agreements (PPAs).

The regulated business in India's electricity sector largely works on 'cost-plus' basis. The basic idea behind this approach is that the tariff is set to recover all 'prudent' costs incurred by the companies. Regulators do set performance norms and disallow some types of costs if the stipulated norms are not complied with. Such an approach has many shortcomings in terms of improving operational and planning efficiency.

The distribution business is based on a 'cross-subsidy' model wherein some consumers – typically industrial, commercial, and large domestic consumers – are charged tariffs higher than the average cost of supply (ACOS) whereas agricultural and small consumers pay a tariff that is much lower than the ACOS. The 'subsidy' thus received from the higher tariffs charged to large consumers is referred to as cross-subsidy. In addition to such cross-subsidy, the state government may allocate explicit revenue subsidy for agricultural pump sets, below poverty line (BPL) households, and a few other consumer categories. In the absence of any monitoring or enforcement of measures aimed at ensuring reliable supply to all consumers, DISCOMs have been relying on the differential supply strategy. Such a strategy, either completely ignores the real and latent demand of small consumers, who lack the capacity to pay, or provides them intermittent and unreliable supply. So long as the overall demand was increasing, power shortages were the norm, and DISCOMs, being the only suppliers, they could continue their business based on this model.

Moving away from power shortages, many DISCOMs today are reported to be power surplus, but find fewer takers for the surplus capacity. The increasing average cost of supply (ACOS) and falling prices of renewable energy are making the 'non-DISCOM' supply options such as renewable-energy-based open access and captive consumption more economical and technically feasible. Given the economic incentives, the high-paying consumers are likely to opt for such non-DISCOM options leading to loss of sales and hence of the cross-subsidy revenue for the DISCOMs. Even without migrating, consumers who have the required space are likely to shift to billing mechanisms such as 'net-metering', which allows them to significantly reduce high cost electricity drawal from the DISCOM. Not surprisingly, the DISCOMs have been resisting these various forms of sales migration by delaying the processing of applications, creating administrative hurdles, levying various surcharges, etc. However, despite such tactics, sales migration has been on the rise and this changing sales mix is likely to affect the DISCOMs' finances adversely. In this context, it is important to review these trends carefully to fully appreciate their implications for the future of DISCOMs.

2.1 Sustained surplus in base power

After struggling with shortages for decades, several states today are facing the challenges posed by surplus power. Sustained surplus in many states is due to massive capacity addition in recent past. In the past decade alone, India nearly tripled its installed capacity of coal-based thermal power, from

71 GW in 2007 to 192 GW in 2017 (CEA, 2007; CEA, 2017). As mentioned in the National Electricity Plan, 2018, approximately 99 GW⁵ of capacity based on conventional sources and approximately 33 GW of capacity based on renewable sources were added during the 12th Five-Year Plan (2012-2017) (CEA, 2018, p. 2.12). This means that a third of the present installed capacity was added in the last 5–6 years alone—much of it was excess capacity and is currently being 'backed down', i.e. not being scheduled for generation, but the DISCOMs are bearing the full fixed costs of such idle capacity.⁶

Given that most states are already power surplus or have contracted more capacity to meet their future requirements and because a majority of the backed-down plants have generation costs higher than short-term market rates, efforts to sell surplus power have not been particularly successful. In some states, the extent and the financial impact of backing down are quite significant, as shown in Table 1. In these states, the fixed-cost payments for backed-down capacity amount to 50%–100% of the government's agricultural subsidy payments to DISCOMs. Most of the current backing down is due to capacity addition that is in excess of both the estimated increase in demand and the actual increase in demand in the past decade. In most states, only 10%–25% of the current backing down can be attributed to reduction in sales due to open access. Considering that sales migration is expected to rise and the fact that the demand growth in recent years has been lower than anticipated, the quantum of surplus power is likely to increase and sustained in the short and medium-term. In the states listed in Table 1, many plants being backed down were built in the past 5–7 years. These plants also have high fixed costs, which add to the financial burden of DISCOMs.

Table 1: Growing surplus power and its financial impact (2015-16)

State DISCOM	Backing down reported (MW)	Backing down as % of contracted capacity	Fixed-cost payments due to backing down (Rs. crore)	Fixed-cost payments for backing down as a % of fixed cost payments to generators	Fixed-cost payments for backing down as a percentage of agricultural subsidies
Rajasthan	1798	14%	1051	16%	59%
Punjab	3457	27%	3006	33%	51%
Maharashtra*	4231	19%	2828	21%	59%
Madhya Pradesh	2444	17%	2177	28%	40%
Gujarat	5525	30%	3823	36%	104%

*Maharashtra data for the year 2016-17

Source: PEG analysis based on various regulatory submissions and tariff orders.

According to the CEA, approximately 48 GW of coal-based capacity is currently under construction, and would be commissioned between 2017 and 2022. State- and central-sector companies are building most of this capacity.⁷ The states that are already surplus also have significant capacity in the pipeline, in some cases about 30% of their current operational capacity. There is also the national commitment to reach 175 GW of renewable-energy-based generation capacity by 2022 and, accordingly, many states are expected to share a large part of this commitment. Even if half of that target is met, it will have a substantial impact on surplus power and backing down. The state electricity regulatory

5. Out of this 99 GW, 85 GW (50 GW added by the private sector and remaining by centre and the states) is coal based, 7 GW is gas based, 5 GW is hydro, and 2 GW is nuclear (CEA, 2018, p. 2.3).

6. Most states follow a two-part tariff structure for generation and the 'merit order dispatch', or MOD, policy for scheduling. Under the two-part tariff structure, the fixed cost of a plant has to be borne by the DISCOM irrespective of whether it generates or not. Under MOD, plants are scheduled for dispatch based on their variable or fuel costs starting with the least cost first. Hence, whenever excess generation is available, the more expensive units or plants would not be scheduled.

7. Based on capacity addition in the pipeline for seven states, namely Maharashtra, Punjab, Haryana, Madhya Pradesh, Gujarat, Andhra Pradesh, and Telangana, and Prayas (Energy Group) analysis based on information, for each station and for each contract, available from regulatory orders, petitions, CEA reports, and state government documents.

commissions (SERCs) are also projecting that some plants, yet to be commissioned, will be backed down in the year they come online because of their high variable costs (PEG, 2017). Such high-cost capacity addition combined with a fall in demand due to rising sales migration would imply sustained surplus baseload capacity with many state DISCOMs for several years.

It can be argued that the DISCOMs can recover at least a part of the cost of this idle capacity by selling it. However, this idea has not yielded the desired results for two reasons: first, it is the high-cost capacity that is being backed down and hence not very competitive; secondly, DISCOMs rely mostly on short-term power market to sell surplus power, where rates are volatile. There are expectations of possible increase in demand on account of factors such as rapid village and household electrification and schemes such as '24 x 7 Power for All', widespread use of electricity for cooking, shift to electric vehicles, and 'Make in India'. However, the contribution and the impact of these emerging and new uses are yet uncertain. Also, the period over which this demand increase will materialise is unclear; in many cases, it may be decades ahead. For example, consider a scenario in which by 2030 all new passenger vehicles would be electric vehicles (EVs). A recent study by Lawrence Berkeley National Laboratory estimates that additional energy demand from EVs in such a scenario would be less than 4% of the total demand in that year (Abhyankar, Gopal, Sheppard, Park, & Phadke, 2017).⁸ Under the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (the Saubhagya scheme for providing an electricity connection to every household), about 4 crore new connections are expected. Most of these households are very poor and based on current consumption of low-income households, it is expected that the monthly consumption of these newly electrified households would not be much beyond 30–50 kWh.⁹ This would translate to additional annual demand of 18 to 30 billion units (BU, or billion kilowatt-hours), equivalent to generation from approximately 3–5 GW of baseload capacity at current plant load factors (PLFs). This would be just about 2 % of current baseload capacity. Further, the uptake of new appliances, especially by the small domestic and commercial consumers, could be impeded by the rising electricity tariffs because such consumption would shift them to a higher tariff slab. Hence, considerable doubts remain about the actual increase in demand on account of these factors without commensurate measures to enable affordable and reliable supply for all.

The current 'surplus' baseload capacity is not a short-term, transient phenomenon. Considering the obligation for fixed cost payments, any excess capacity will either continue to contribute significantly to the financial distress of DISCOMs or will most likely turn into a non-performing asset (NPA).

2.2 Rising average cost of supply

Apart from the costs of surplus capacity, DISCOMs also face other challenges such as high AT&C losses and the increasing cost of the wires business. These factors increase the ACOS, which is the cost that a DISCOM incurs in supplying one unit (1 kWh) of electricity. Our analysis of tariff orders of various state-owned DISCOMs shows that the ACOS was about Rs. 7/kWh in 2015–16 and has been steadily increasing at an average rate of approximately 6% per year¹⁰ for the past 3–5 years.¹¹ Even assuming a modest increase of 4% per annum, the actual ACOS for a typical DISCOM would be approximately Rs. 8.5/kWh in the next 3–5 years across states.

8. As per the assessment, even if parameters such as sales growth and efficiency of electric vehicles and the vehicle-kilometres travelled are varied by 25%, energy consumption by electric vehicles by 2030 will be about 62–103 TWh, which accounts for only 2%–4% of the energy requirements for that year.

9. In Andhra Pradesh, DISCOMs have reported that about 40% households use less than 50 units a month and in Maharashtra, about 65% residential consumers use less than 100 units a month. Both Andhra Pradesh and Maharashtra are industrialised states that had achieved high levels of household electrification decades ago.

10. All the growth rates and/or changes in percentage terms referred to in this report are on nominal basis.

11. Based on an analysis of tariff orders, true-up orders, and petitions by state-owned distribution companies in Madhya Pradesh, Bihar, Maharashtra, Gujarat, Andhra Pradesh, Haryana, Rajasthan, and Telangana, which are collectively responsible for more than 70% of electricity sales in India.

Power purchase cost accounts for about 75% of the DISCOM's cost of supply. Coal-based generation accounts for about 75% of total generation, and almost all thermal capacity in the pipeline is also coal based. Most of this capacity is regulated under the cost-plus regime and in the past, has found it difficult to operate within the performance norms specified by the regulator (PEG, 2017, p. 69). As a result, and also on account of a steady increase in fuel-related costs, the variable cost of these plants is quite high. Plus, the capital cost per megawatt for most of the newly commissioned units is also quite high (roughly Rs. 7 crore or more), largely on account of delays in plant construction and commissioning, which increase the interest-during-construction (IDC) component of the capital cost. As a result of these factors, the fixed cost of newly commissioned units is on average approximately Rs. 2/kWh.¹² Further, renovation and modernization of existing thermal capacity would be necessary to improve operational efficiency, reduce emissions, and to comply with the 2015 environment regulations.¹³ This would further increase the fixed cost of coal-based generation and hence the ACOS of DISCOMs.

Driven by the need to augment and expand the network and partly on account of inefficiencies, the network costs of transmission and distribution (T&D) are increasing substantially across states. Another reason for the increasing cost of wires is the rapid increase in operation and maintenance (O&M) costs as well as the costs related to capital expenditure. Some of these increased expenses are necessary, especially those incurred on evacuating renewable-energy-based power and strengthening and expanding the rural distribution network, especially in states with poor access to electricity. However, there is also significant inefficiency in both O&M and capital expenditure, which is evident from the long and frequent delays in project completion and poor supply and service quality.

The average cost of supply for DISCOMs is likely to continue to increase by about 4 to 5% per annum in the short to medium term. This is largely on account of the increasing cost of conventional generation, which forms a substantial part of a DISCOM's power purchase cost, and also on account of the increased network costs for transmission and distribution.

2.3 Sales migration

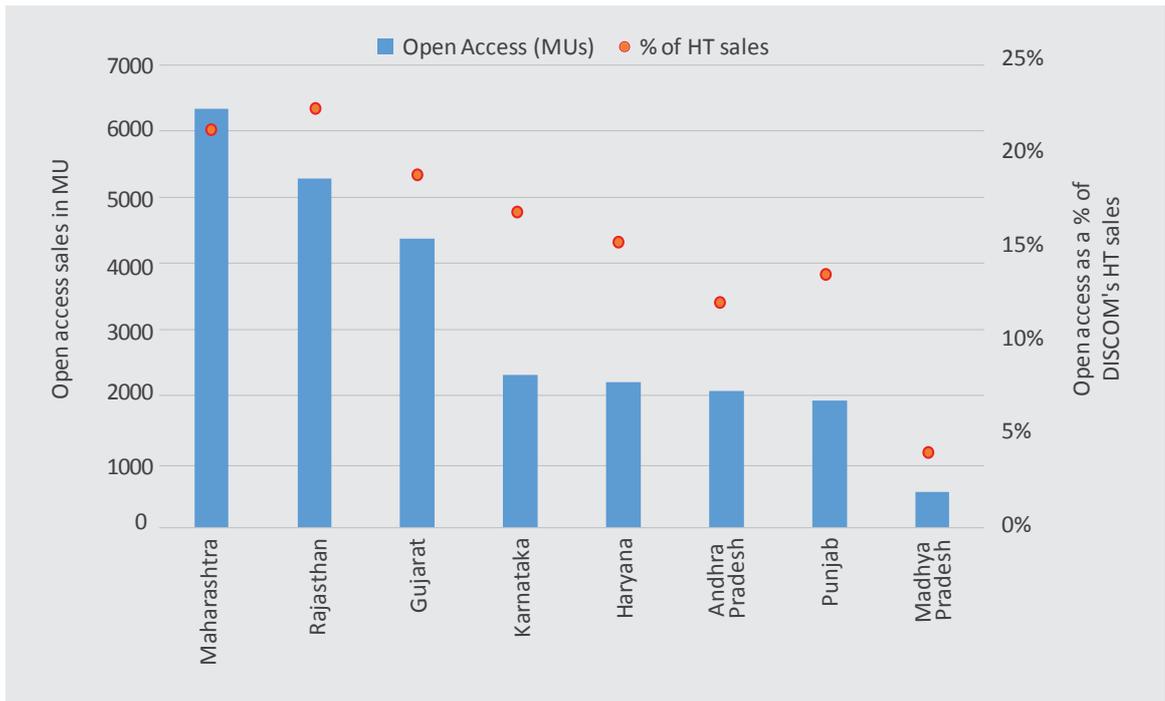
Many states are witnessing a significant rise in sales migration, largely on account of open access and captive consumption. Figure 2 shows the extent of open access sales in million units (MU, i.e. 1 million kilowatt-hours) in FY 17 in eight Indian states. The striking finding is that in some of the large states such as Maharashtra, Gujarat, and Rajasthan, open-access sales are already as high as 20% of the respective state DISCOM's current figures of high-tension (HT) sales. Most of these open-access sales are short-term, largely on a day ahead basis. Short-term transactions by open-access consumers account for more than 60% of the trade on power exchanges. Naturally, such sales migration has significant impacts on a DISCOM's revenue as well as, operations and planning for power procurement, because it adds to demand uncertainty and makes the management of the DISCOM's thermal fleet a challenging task.

Apart from open access, captive consumption has also increased steadily in the past three years. Figure 3 shows how captive consumption has varied in different states from FY 15 to FY 17 and has already reached 20%–30% of the total sales of many DISCOMs. Between FY 14 and FY 15, captive consumption increased by 9% in Odisha, 12% in Chhattisgarh, and as much as 34% in Karnataka. Additionally, as of September 2017, the installed rooftop solar capacity was estimated at 1871 MW and is growing rapidly, accelerated by net metering provisions, competitive prices of solar panels, and rising DISCOM tariffs.

12. Based on the analysis of capacity commissioned since 2012 in states such as Maharashtra, Gujarat, and Uttar Pradesh

13. NTPC Ltd. has estimated that the cost increase needed for complying with the 2015 environmental regulations would be about Rs. 0.50/kWh whereas the Association of Power Producers has estimated it to be about Rs. 0.80/kWh (Sengupta, 2016)

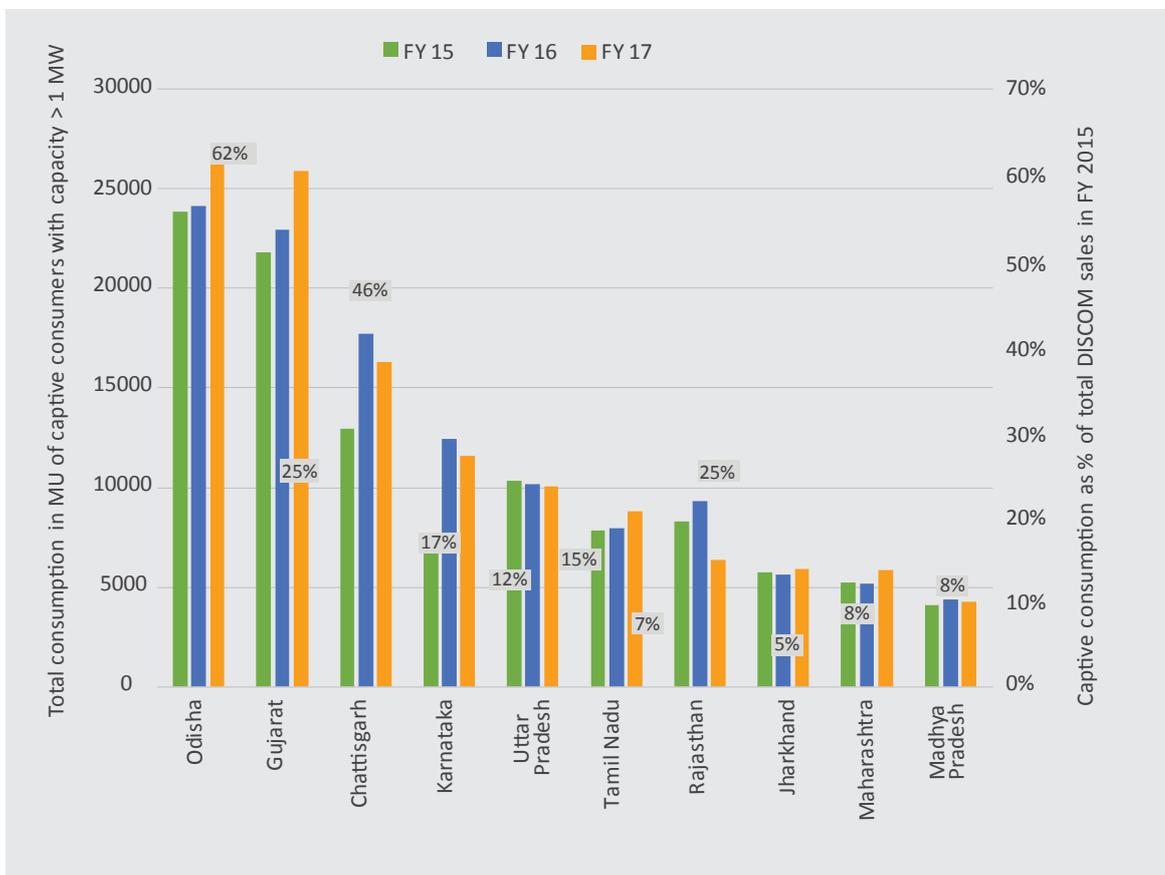
Figure 2: Sales migration on account of open access in various states in FY 16-17



Note: Estimates for Rajasthan are for FY 16 and those for Madhya Pradesh are from Sept. 2015 to Aug. 2016.

Source: Compiled by Prayas (Energy Group) from regulatory orders and petitions based on estimates or actual sales reported by DISCOMs.

Figure 3: Consumption (MUs) by captive consumers with loads greater than 1 MW



Source: CEA General Review (CEA, 2017; CEA, 2016; CEA, 2015).

Open access and captive sales migration are no longer merely emerging trends, but a reality for most DISCOMs, which is leading to a significant loss in cross-subsidising revenue. Open access is mostly short-term and it makes planning for power procurement more challenging. Additionally, sales migration (through open access, captive consumption, and rooftop solar) is increasing despite procedural hurdles, high cross-subsidy surcharge, and the imposition of additional surcharges. With the rising cost of supply by DISCOMs and the falling cost of renewable energy sources, this trend is likely to intensify.

2.4 Competitiveness of alternative supply options

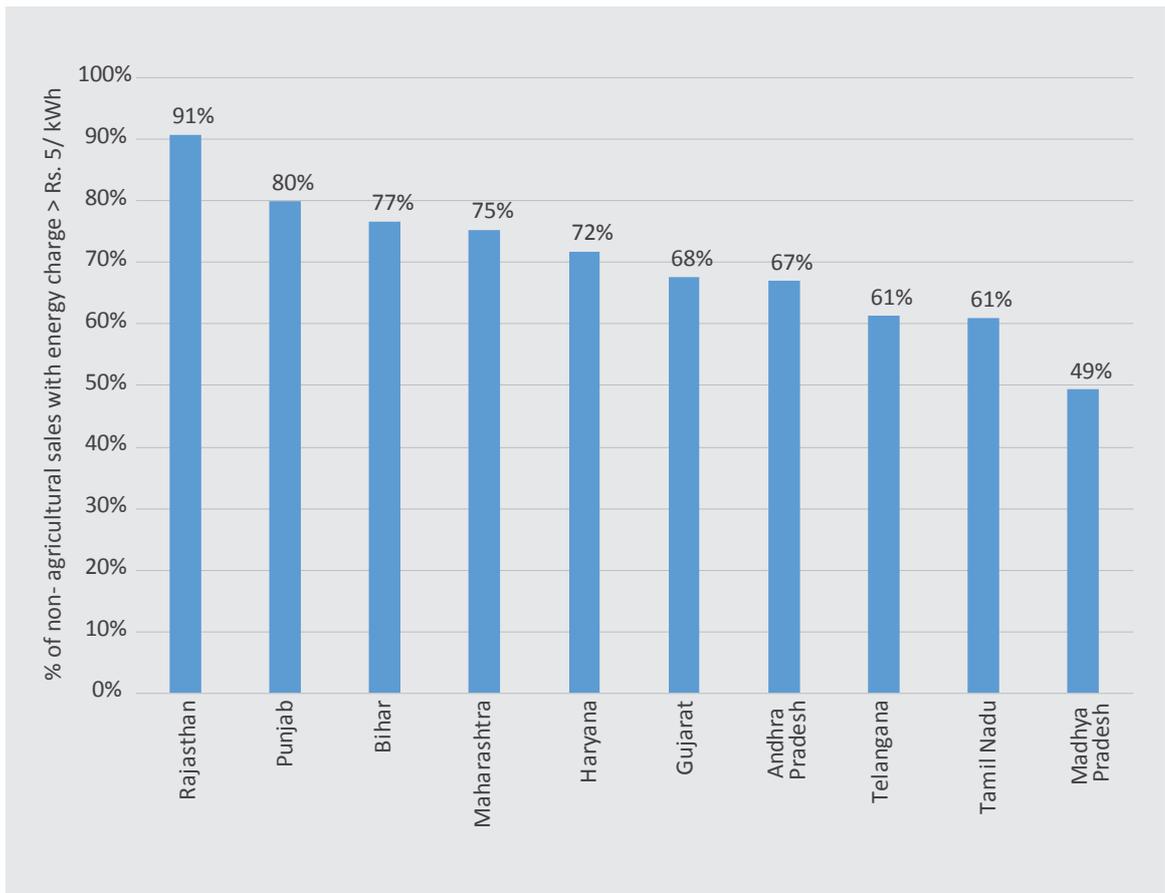
Although migration on account of open access and captive consumption is on the rise, DISCOMs often do not take that into account while forecasting demand during the tariff determination process. For example, in many states the actual sales to HT industrial consumers have been falling, but DISCOMs and SERCs have consistently projected a much higher growth rate (PEG, 2017, p. 19). There are two reasons for such projections: 1) to justify the existing plans for power procurement and capacity addition and 2) to match the revenue requirement with the projected revenue from tariff, thus artificially reducing the expected revenue gap and underestimating tariff increase required.

The finances of DISCOMs are heavily dependent on revenue from these cross-subsidising consumers and hence the DISCOMs keep trying various measures to retain these high-paying consumers. Such measures include offering rebates for off-peak consumption, waivers on duty or explicit revenue subsidy by the state government, tariff design that lowers the energy charge by increasing the fixed charge, or even creating procedural hurdles to deny/delay migration.

With the rapidly reducing costs of solar and wind power, alternative modes of supply would become competitive for many consumers, and DISCOMs will find it harder to retain them. Currently, it is expected that rooftop or ground-mounted decentralised kilowatt-scale solar PV systems without storage would be available at a generation cost of about Rs. 5/kWh or even less, and since the variable component is negligible, this cost would be more or less constant for the next 25 years. As against this, most consumers, especially non-agricultural consumers, pay a much higher tariff, even in just energy-charge terms, and it keeps increasing over the years. As discussed earlier, the ACOS of distribution companies is already Rs. 7/kWh and, in a business-as-usual scenario, expected to increase to about Rs. 8.50/kWh in the next 3–5 years. Thus, a cross-subsidising consumer is likely to pay a tariff that is much higher than this cost.

Consumer tariff has two components, a fixed charge and an energy charge. Figure 4 shows the share of non-agricultural sales with energy charge greater than Rs. 5/kWh, which is considered the indicative tariff for rooftop solar systems. For example, in case of Maharashtra (MSEDCL) 75% of non-agricultural sales are at energy charge of over Rs. 5 / kWh. From the figure, it is clear that in most of the states, about 70% of the non-agricultural sales have an average energy charge of more than Rs. 5/kWh, excluding electricity duty / tax, fuel adjustment charges etc. This indicates that so long as space is available, it is already economically attractive for these consumers to switch to rooftop solar-based supply, either through net-metering or captive power or open access, depending on the state-specific charges and regulations. There are already innovative business models where investors or developers put up the system and charge consumers only on the basis of actual generation. This further increases the financial viability of adopting rooftop solar systems as consumers do not have to make any upfront investment, but only pay developers every month on the basis of actual solar generation. Such business models, combined with lucrative prices compared to DISCOM tariff, will encourage a massive sales shift away from the DISCOM in the coming years.

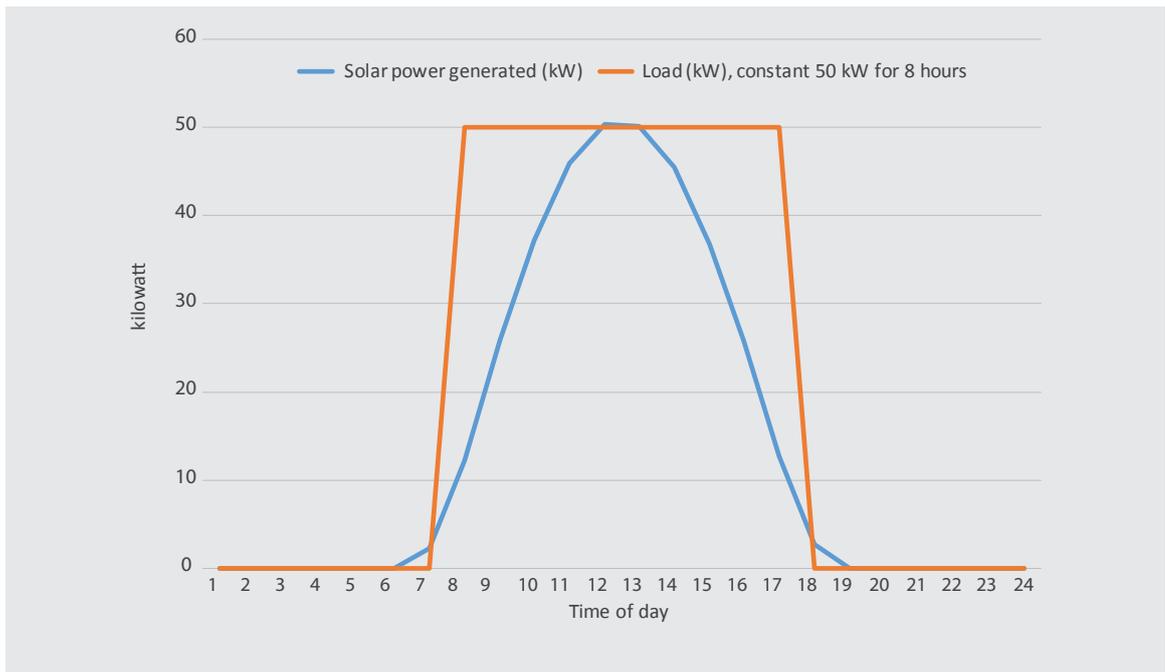
Figure 4: Share of non-agricultural sales with energy charge greater than Rs. 5/kWh



Source: PEG analysis based on regulatory orders from various states.

One could argue that the difference between the energy charge and the cost of alternative, solar-based supply alone may not be enough of an incentive for reducing the offtake from DISCOMs, mainly because of the diurnal nature and the variability of solar generation. Also, as a part of their efforts to limit sales migration, DISCOMs may choose to impose restrictions on net-metering or push for withdrawal of the benefit altogether. Even considering such a scenario and without the benefit of net-metering, consumers with energy charge higher than Rs. 5/kWh would yet make significant savings by simply meeting a major part of their daytime demand through solar generation. As illustrated in Figure 5, even without net-metering, a consumer with a predominantly daytime load of 50 kW may opt for a solar PV system of about 75 kW and can save around Rs. 2/kWh because of the difference between the energy charge (Rs. 7/ kWh and rising) and the cost of solar PV (Rs. 5/ kWh). Thus, it would yet be economical for a consumer to opt for solar installation so that most of the daytime load is met through the solar PV system and the excess generation, if any, is allowed to be 'wasted'. If the DISCOM creates further policy or regulatory or procedural hurdles for consumers opting for such solutions, a combination of an oversized solar PV system and a battery storage system could be used to overcome even such hurdles, as illustrated in Annexure 1. Thus, the DISCOMs, at the most, can delay significant penetration of such systems by a few years—they will not be able to prevent large scale adoption of such alternate sources. Considering these economics, the social and environmental desirability of such renewable options, and our national commitment to clean energy sources, policy or regulatory roadblocks are unlikely to prevent the proliferation of such decentralised systems beyond a point.

Figure 5: Using solar to offset major part of daytime load



Note: Solar output shown here has been simulated for an indicative site in central India.

Source: Prayas (Energy Group) analysis.

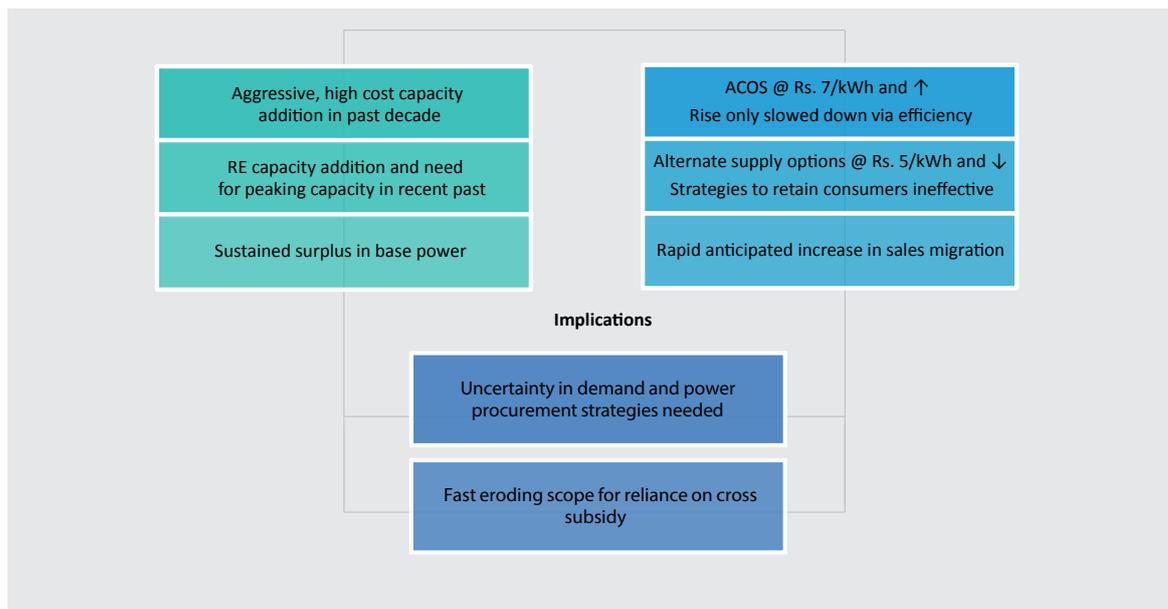
Renewable energy prices are already competitive with DISCOM tariffs. In most states, about 70% of non-agricultural sales are to consumers paying energy charges higher than Rs. 5/kWh, the indicative price for power from rooftop solar PV. Moreover, with rising grid tariffs, many consumers may decide to reduce their reliance on the grid even further. With falling storage costs, this is a possibility since an oversized solar PV system with an appropriately sized lithium-ion battery pack, predominantly to meet the daytime load will cost only about Rs. 7/kWh in the not-too-distant future. This is still less than the average cost of supply for the DISCOM in many states, creating a strong incentive for consumers to reduce day time drawal from DISCOM.

2.5 Implications of impending changes for the future of DISCOMs

Based on the trends discussed in the earlier sections, two key implications become evident: **the future demand that DISCOMs need to meet is going to be highly uncertain, both in terms of quantum and nature (daily and seasonal variations), and the cross-subsidy-based approach to tariff will need to be abandoned soon.**

Figure 6 illustrates some of the issues discussed so far and their implications.

Figure 6: Challenges before the DISCOM in the near future



Source: Prayas (Energy Group).

As highlighted, several economically attractive alternatives to supply by DISCOMs become available to consumers, the surplus capacity contracted by DISCOMs may not get absorbed easily, although the overall demand at the state level may continue to increase. This makes power purchase, especially through new, long-term, contracts, an extremely risky and challenging proposition for DISCOMs. As being experienced at present, any excess capacity will lead to either a greater burden on DISCOMs of repaying the fixed costs (thereby increasing their cost of supply) or a greater danger of being left with stranded capacity and non-performing assets.

The primary driver for sales migration is the increasing ACOS while cheaper supply options are available. Because of this, more and more subsidising consumers are likely to opt for other supply options, leaving DISCOMs with mostly the 'non-contestable' small and rural consumers, who would find it hard to switch suppliers. Loss of cross-subsidising sales would also mean that DISCOMs will need to charge these small and agricultural consumers higher tariffs. For example, even to match ACOS, tariff for these consumers will need to increase by more than 10%–20% every year for the next 4–6 years. Hence, as consumer migration picks up, if the tariff shock for the small consumers is to be avoided, the state governments will need to bear a higher share of the revenue gap, which will compound the financial troubles of state governments already saddled with the DISCOMs' losses under UDAY. Even at current levels of cross subsidy, state governments are struggling to keep up with their subsidy commitments¹⁴—any increase in such liabilities is likely to jeopardise the finances of not only DISCOMs but also of the states.

These possibilities are discussed in greater detail subsequently. The next two subsections reflect on two potential options of mitigating the adverse impacts discussed above and briefly evaluate the potential and the feasibility of those options.

14. Currently revenue subsidies provided by state governments across the country is more than Rs. 70,000 crores per year. This is more than the cumulative investments in central sector rural electrification programmes since 2005 (RBI, 2017).

The uncertainty in demand on account of competing supply options and loss in cross subsidy on account of consumer migration is likely to have two serious implications for the DISCOM's future: 1) planning for power purchase, which has always been a weak link in the DISCOM's business model, is likely to become even riskier and more complex and 2) the loss of cross-subsidising consumers would force DISCOMs to increase the tariff for small, rural, and agricultural consumers, which, in turn, would increase the need for direct revenue subsidy by state governments. Both the factors, if not managed appropriately, can lead to severe financial stress, not just for the DISCOMs but also for the sector at large.

2.6 Improving efficiency to avert the need for tariff increase

Given the high aggregate technical and commercial (AT&C) losses and inefficiencies in planning for power purchase, one could argue that DISCOMs can avert the need for tariff increase by improving efficiency. Similarly, it can also be argued that the union government and the state governments can devise suitable policies to reduce the cost of grid-based power. Some examples of such efforts include cutting distribution losses by 2%–4% every year or to 15% by 2022, increasing efficiency in implementation and execution of capital expenditure projects to lower the cost increases from 10% to 5%, improving O&M, or improving the station heat rates of thermal power plants, thereby making it possible for the plants to operate at normative parameters and thus avoid any additional increase in the variable cost of generation. However, an indicative analysis for a typical DISCOM shows that despite implementing some of the above-mentioned measures over the next 5 years, the ACOS is likely to increase by 2%–3% – instead of 5%–6% – per annum due to factors such as the cost of some capacity additions already under way which will need to be borne by the DISCOMs, efficiency improvement measures will need fresh capital expenditure, which may need some time to show results. Additionally, some increase in cost to meet such recurring expenses as wage increases and loan repayments is unavoidable, even if most of the costs are managed efficiently.

Without debating the feasibility or sustainability of such measures to improve efficiency, the analysis highlights that even stringent measures can at best slow down the rate at which the ACOS goes up from the business-as-usual rate of 5%–6% to 2%–3%.

Efficiency improvement has always been a challenge for the distribution sector. Analysis shows that even with best efforts and ambitious targets of efficiency improvement, growth in the average cost of supply can at best be reduced from 5%–6% to 2%–3%, but the costs would still continue to rise. As against this, the cost of other supply options is rapidly falling. Hence, although efficiency improvements are necessary and desirable, they may not be sufficient for mitigating the adverse impacts of the impending changes in the sector.

2.7 Altering tariff design to help retain high-paying consumers

Since DISCOMs would try hard to retain their high-paying consumers, it is important to consider what role could be played by tariff design in such efforts. Strategies such as increasing revenue from fixed charges or implementing time-of-day tariffs have already been tried to discourage open access. The effectiveness of these strategies are discussed in this section.

2.7.1 Increasing fixed charges while keeping tariffs the same

It can be argued that DISCOMs can increase their revenue by increasing the fixed charges while keeping the total tariff for the consumer the same. Such a move would reduce the energy charges paid by the consumer. Often, open-access consumers (mostly over a short-term) retain some demand with the DISCOM and thus pay the fixed charges monthly, either in full or in part. The loss of revenue due to sales migration is usually due to loss of energy charges and therefore, the competition with alternative sources takes place on the basis of energy charges. The idea behind increasing fixed charges is that

such an approach would discourage migration. Such a strategy would not be very effective in the medium-term as it may encourage consumers to move towards captive generation.

Consider a typical 1 MW+ consumer, who requires power eight hours a day. To reduce energy charges for this consumer, suppose the fixed charges are increased by 100% while keeping the total tariff constant. Table 2 shows the impact of this change if it were to be applied to 2017-18 tariffs in six states. In the states considered, the energy charges decrease by about 10%–15% but, despite such decrease, the costs remain higher than those from stand-alone solar PV systems (Rs. 5/kWh) and hence is not enough to discourage migration. Besides, the annual fixed-cost payments, after the change in tariff design are comparable to 10%–15% of the present capital cost of a solar PV system. Thus, changing tariff design in this manner is unlikely to reduce the cost-competitiveness of solar-power-based supply and may even encourage consumers to invest in captive PV plants and to reduce the contracted demand with the DISCOM, which would also lower their fixed-cost payments.

Table 2: Increasing fixed charges to lower energy charges of cross-subsidising consumers

States (2017-18)	Modified energy charge (Rs/kWh)*	Reduction in energy charge (%)	Annual fixed-cost payments (Rs. lakhs)	Annual fixed cost as a % of capital costs for a 1 MW solar plant#
Maharashtra	6.31	15%	65	16%
Gujarat	4.69	15%	49	12%
Rajasthan	6.54	10%	44	11%
Karnataka	6.09	14%	60	15%
Haryana	5.85	11%	41	10%
Tamil Nadu	6.04	12%	49	12%

* For a given consumer category, keeping the total tariff constant if the fixed cost is doubled, the energy charge will decrease. The modified energy charge is calculated in this manner using data for a typical 1 MW consumer connected at 33 kV and assuming 8 hours of daytime load.

Capital costs for solar plants are assumed to be Rs. 4 crore per megawatt.

Source: PEG analysis based on tariff orders by different states.

2.7.2 Reduction in tariff through time-of-day rebates and subsidies

As most of the open access in India is short-term, consumers switch continually between the DISCOM and the market, based on price signals. To induce the cross-subsidising and high-paying consumers to remain with a DISCOM, especially during off-peak hours when there is surplus capacity, many SERCs and DISCOMs provide rebates based on time-of-day (ToD) tariffs. However, such a strategy may also fail, given the competitiveness of the alternatives. For example, Maharashtra provides a rebate of Rs. 1.50/kWh of power consumed during off-peak hours. However, in FY 2016, the quantum of open access during off-peak hours was the same as that during peak hours, despite a penal rate of Rs. 1.10/kWh for migration during peak hours. Some states such as Punjab, Andhra Pradesh, and Maharashtra have also tried reducing the tariffs for cross-subsidising consumers. However, data show that even a reduction in HT tariffs has not prevented sales migration. In FY 2016, Maharashtra reduced the tariff of HT consumers by approximately 16% by introducing a subsidy; however, despite the subsidy, open access increased by 29% during the same period.

Thus, given the high costs of DISCOMs, there seem to be no levers, especially in medium-term, for tinkering with tariff design to retain high-paying consumers.

Traditional methods to stall open access by tweaking tariff design will be ineffective given the increasing costs for DISCOMs and the falling prices of alternatives. Already in many states such strategies as increasing the revenue from fixed charges while keeping tariffs the same or reducing energy charges, increasing time-of-day rebates to encourage off-peak consumption from the grid, and reducing tariffs for HT consumers through subsidies or rebates are proving ineffective.

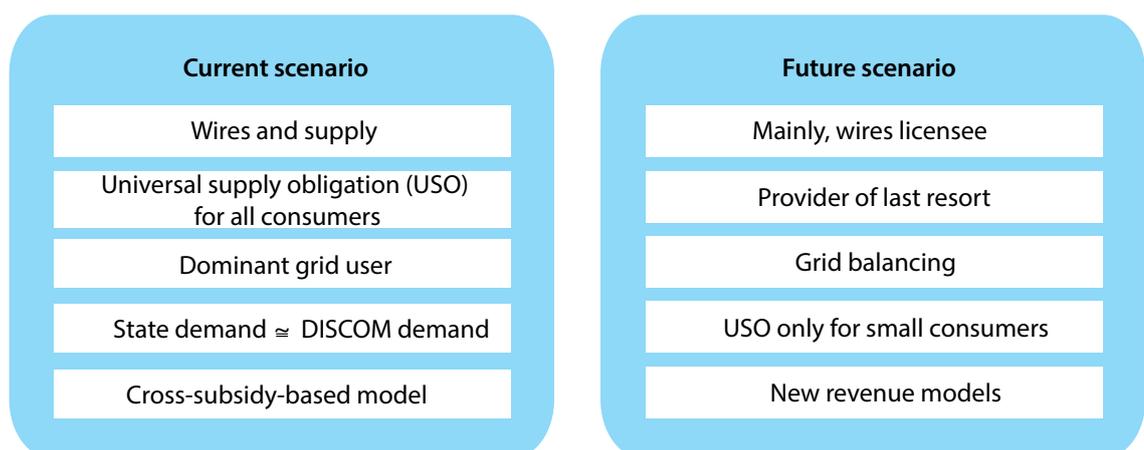
3. Transition path for the 'future' DISCOM

The trends discussed in the earlier sections are interlinked and interdependent and raise fundamental questions not only of viability but also of the feasibility of continuing with the current business model of DISCOMs, which is based on the following practices.

- Revenue recovery is based on the 'cost-plus' method of determining tariffs, which offers little incentives for improving efficiency.
- Cross – subsidy based tariff design.
- The consistently increasing demand is met mainly by buying baseload power, largely through long-term contracts, and often on cost-plus basis.

With most of the big and high-paying consumers (in terms of their share in total sales) substantially reducing their dependence on DISCOMs for the 'supply' function, a DISCOM will need to transition from being the only major supplier catering to most of the demand in its license area to being mainly a wires licensee who is also one of the many suppliers. Additionally, with options such as net metering, many of the DISCOM's consumers would also be 'prosumers', making demand estimation and load management even more challenging. As long as open access was not a serious option, a DISCOM was the most dominant grid user in the state and hence exercised a much stronger control over the grid. However, with multiple suppliers entering the scene, the DISCOM would also need to play the role of a grid-balancing agent. As observed earlier, most of the open access is short-term, which means that the DISCOMs will need to manage this variability, as they are also likely to be the suppliers of last resort for most open access and captive consumers. Managing variability during the transition is a challenge for the largely coal-based fleet of DISCOMs.

Figure 7: The changing role of the DISCOM



Source: Prayas (Energy Group).

Ultimately, one of the major imports of these trends is that whereas the cross-subsidising consumers will be able to explore and avail themselves of the alternatives to DISCOM supply, most rural and small consumers will continue to depend on the DISCOMs. This would be a major change in the political

economy of DISCOMs, who have traditionally been responsible for meeting the entire demand of a state and especially that of the big industrial and commercial consumers—the change in its sales mix that entails shrinking demand from such big consumers is likely to weaken a DISCOM's financial situation even more and also raises concerns regarding the supply and quality of service offered to small, retail consumers.

Although DISCOMs have been aware of the changing nature of their business, their response has largely been in the form of penalties or incentives aimed at discouraging consumer migration so as to protect the revenue from cross subsidies. The data highlighted above indicate that this response is unlikely to prevent the impending transition but may, at best, delay the inevitable for a short while. Considering the already 'surplus' status of most DISCOMs, continuation of the current approach to planning, and the absence of market instruments that allow effective use of the existing stranded capacity or market-determined capacity addition, the imminent danger is of further increase in the already high quantum and cost of stranded capacity.

One possible – and dangerous – outcome of this emerging scenario is the collapse of the DISCOM. Besides being a huge financial blow to the state and to the exchequer, such collapse would be detrimental to meaningful access to electricity for the small and rural consumers and also highly undesirable for grid stability, because even in a financially precarious position, the DISCOM will probably continue to be the major wires licensee and the provider of last resort for a large number of open-access and captive-power consumers. It is therefore in the sector's as well as society's interest to ensure that DISCOMs manage a smooth transition to the future and are able to fulfil their new role competently and efficiently—and the way to achieve those aims is to quickly usher in changes that will help the distribution sector to adapt to and cope with the emerging trends.

4. Suggested ideas for way forward

The analysis so far emphasises that the traditional model of managing the distribution sector in India is on the verge of collapse. More important, it is not just the fate of DISCOMs that is at stake—as electrification accelerates and millions of newly electrified households join the grid, also at stake is the fate of all the small, rural, and agricultural consumers, and that depends on how we manage the DISCOM's transition to the future. Although the emerging trends are likely to add to the uncertainty and financial troubles of the already stressed DISCOMs, these disruptive forces can also be seen as opportunity to fundamentally reform the distribution sector. This section offers some ideas to achieve the objectives of turning the impending transition into an opportunity to bring in desirable changes and to make the inevitable transition more orderly and equitable.

The proposed ideas represent a broad contour of the way forward and not a blueprint for sector reforms. Further work would be needed to refine these ideas and develop appropriate policy, regulatory measures for the same. The suggested approach is also represented as a schematic in Figure 9.

4.1 Shrinking the pie: regulated supply only for small consumers

To survive, DISCOMs need to move away from the cross-subsidy-based revenue model; if they do not, they will keep trying harder to retain the high-paying, cross-subsidising consumers, inadvertently pushing them further from the grid – a situation akin to a death spiral.

Currently, many big consumers are procuring their energy requirement, partly or fully, through short-term open access. While doing so they also retain contract demand, and hence have a right to draw their energy requirement from DISCOM. Because of this, the DISCOM also plans for meeting the demands of these consumers. As a result, the burden of adding to baseload capacity and its rising costs falls on the DISCOM. In the next 5–10 years, as alternative sources of supply become cheaper, such large consumers will further reduce their drawal from the grid, leaving the remaining – and subsidised – consumers with a huge burden of high-cost stranded capacity. Therefore, it is imperative that this transition be anticipated and dealt with in phases, and those consumers interested in procuring electricity independently be asked to share both the risks and the rewards of such migration.

In a business-as-usual scenario, without accounting for consumer migration and projecting the state demand as its own demand (whether fully met by it or not), the DISCOM will keep adding more capacity. The experience of several states shows that in spite of various regulations and guidelines, the process of estimating demand is seldom based on rigorous data and analysis (PEG, 2017) and is often fraught with challenges of governance when it comes to selecting the least-cost supply options. To break this vicious cycle, the following steps are proposed as measures aimed at improving the planning, operations, and accountability of DISCOMs. It should be noted that these steps should be taken in tandem and not in isolation, lest they should create more problems for DISCOMs.

4.1.1 Long-term sales migration to ensure demand certainty and market development

Most of the open access in India is short-term and therefore DISCOMs have to plan to cater for the demand for these consumers even though there is a high degree of uncertainty in sales. Further, with the proliferation of group captive and renewable energy based captive options, the dependence of the consumers on the DISCOM to meet demand is unclear.

For open access and retail competition to flourish, a robust market must exist for migrating consumers to procure power from. Currently, with short-term open access, generators of power also have no certainty of sustained demand from consumers, and power markets cannot develop without such certainty.

In order to reduce the uncertainty in demand and power procurement strategies, DISCOMs should actively encourage consumers opting for open access and captive options to do so on a long-term basis. In the short-run, such a move will result in significant revenue loss for the DISCOM. However, with the cost-competitiveness of alternate options, the large scale migration of cross-subsidising consumers is inevitable in the medium-term. Therefore, initiating a phase-wise, long-term migration of such sales could aid better planning, power procurement and targeted investments by the DISCOMs.

Some of the broad steps which can be undertaken by the DISCOMs to encourage long-term, phase-wise reduction of demand from large consumers include:

- DISCOMs and SERC should stop the practice of allowing short-term open access in one to two years, and minimum duration of open access should be extended to minimum of one year initially and increased to three years subsequently.
- In three to five years, consumers with a demand less than 1 MW (say 0.5 MW at first and then eventually even 50 kW) can be made eligible to avail open access. Such a move can help broaden power markets and aid the proliferation of demand aggregator business models as well.
- Open access consumers may meet their demand through multiple power procurement strategies and DISCOM can also be one of the suppliers. However, DISCOMs should charge sufficiently high tariffs to discourage such dependence or this activity should be treated as 'non-regulated' activity with DISCOM not allowed to include any cost, demand or contracts relating to such business in regulated business accounts.
- DISCOM role to support captive or open access consumers would be limited to wires licensee and supplier of last resort. There should be well defined contracts signed for the period of migration which details the responsibilities of DISCOM as the provider of last resort, the mechanism for levying and collecting various charges, and the mechanism for metering and billing.
- Sales migration charges such as wheeling charges, cross subsidy charges, additional charges and parallel operation charges, levied on migrating consumers should be fixed for a five-year period to provide price certainty to migrating consumers. Currently, the variation in these charges is significant. Fixing the charges also implies that the charges reduce over time on a real basis. Additionally, fixing the charges also provides signals to improve efficiency, rationalise power procurement strategies and reduce cross subsidy dependence for DISCOM.
- Over and above the revenue from sales migration charges, time-bound support for the DISCOM might be necessary to compensate for the revenue loss during the transition. This can be financed through subsidies or through a surcharge or duty or cess on all users of the grid (i.e. all non-discom energy supply including captive) levied by the state government. The revenue loss of the DISCOMs can also be curtailed by removing the concessions to renewable energy based open access as this may not be necessary given the cost-competitiveness of renewable energy.

To help a DISCOM's transition to a 'future' DISCOM, it is imperative that cross-subsidising consumers with multiple supply options migrate early and for good. Short-term open access should be discouraged by stipulating a minimum duration of 1 year. However, open access for a minimum of 1 year as well as captive power should be encouraged by removing administrative hurdles, ensuring certainty, gradually lowering sales migration charges, drawing up clear contracts between the DISCOM and the migrating consumers, and lowering the eligibility criteria for open access. Support is essential during the transition and can come from time-bound duties, cess on all grid users including captive, and removal of concessions for open access based on renewable energy.

4.2 No new long-term, baseload power purchase by DISCOMs without rigorous demand assessment

If the role of the DISCOM is to be transformed, it is important to limit its liabilities. This would be possible if more and more consumers procure electricity through market-based mechanisms. As highlighted before, there is already a significant surplus capacity with many states and, given the capacity additions in the pipeline and the targets for adding renewable-energy capacity, that surplus is likely to remain in the coming years. Indicative calculations suggest that even assuming that LT demand will grow by 5%–7% every year, and with large share of HT sales moving away from DISCOM, most states may not need new capacity for the next decade or so beyond the already contracted thermal capacity under construction. Even at the national level, CEA's recent NEP estimates that no new capacity addition, apart from the 48 GW that is already under construction would be required till 2022. Further, it estimates retirement of about 48 GW capacity by 2027 and new capacity, preferably peaking, would be required to address this shortfall (CEA, 2018, p. 5.12). Given this situation, it would be prudent to first use all the existing stranded capacity to the fullest extent and to allow further capacity addition only after this is achieved. Similarly, the possibility of using the currently stranded capacity for meeting seasonal or peak demand should be explored, as that option may prove more economical than adding new capacity.

Mandating long-term open access can be a major boost to exploiting the existing excess capacity. The migrating consumers could source their supply from market, including surplus power available with DISCOMs. The increase in a DISCOM's demand could be met by the capacity made available because of migrating consumers, addition of renewable-energy capacity, and contracted capacity expected to be commissioned soon. The existing depreciated generation capacity could be reserved for the non-contestable, regulated, small consumers, whereas the big consumers could participate in market-based pricing for generation. These measures will ensure that players who are better suited to manage market risks make appropriate decisions on future capacity addition. The contract design also needs urgent re-think as far as PPAs for baseload conventional power are concerned. Components such as a two-part tariff structure, a 25-year contract, and normative availability declared every year need to be re-evaluated given the changing nature of the sector. Therefore, considering all these factors, most DISCOMs need to avoid signing any long-term contracts for any new baseload capacity for the next few years.

Given the uncertainty in sales mix, if at all any new capacity addition is required, it should be based on rigorous data and analysis, and there should be public scrutiny of the demand assessment made by the DISCOM. Interestingly, tariff regulations of many states¹⁵ require the DISCOMs to undertake detailed and long-term demand forecast analysis factoring in estimates for captive consumption, open access, impact of DSM measures, and distributed generation. The regulations stipulate that an integrated power procurement plan based on such forecasting exercise consider seasonal load variations, unrestricted base and peak load, and least-cost alternatives before undertaking any new capacity addition. Unfortunately, these provisions are seldom implemented either in letter or in spirit.

15. States such as Maharashtra, Karnataka, Haryana, Andhra Pradesh, Punjab, and Rajasthan have tariff regulations with such provisions.

Recently, in a welcome development, the Maharashtra ERC undertook a suo-motu review of the capacity addition plan of the state generation and distribution companies. Through this process, the MERC mandated that before tying up any further generating capacity in the state, the companies must present a comprehensive plan that includes detailed demand –supply analysis, competitiveness of various generation options, including renewables (MERC, 2018). More importantly, it has directed that any fresh capital expenditure incurred towards new capacity addition without prior approval of such comprehensive plan would be at the state generation company's risk and cost. This is one of the first order by a state ERC mandating comprehensive review of capacity addition plans. It is expected that such efforts would lead to more opportunities for rationalising state level capacity addition process.

Considering the changing dynamics of the sector, a rigorous and analytically robust planning exercise should use analytical tools such as load forecasting models and various power sector models. These tools allow comparison of costs and planning approaches across several potential future scenarios and the sensitivity of important parameters such as growth in demand, load shapes, sales migrations, and the value of different generation technologies to meeting load. Hence, before taking any decisions on adding new capacity, DISCOMs should be required to first undertake a detailed capacity-planning exercise that considers all the potential supply options (base, peak, and intermediate) along with energy efficiency measures and other low-cost alternatives.

Given the surplus capacity and uncertainty in both demand and supply, it is important to first use all the existing stranded and surplus capacity to the fullest extent, and to allow further capacity addition only after this has been achieved. Even considering the rare situation in which new capacity addition is required, it should be allowed only after a rigorous and robust analysis of demand as well as supply alternatives using such analytical tools as load forecasting models and power sector models. To ensure public accountability, all the data used and assumptions made for such modelling and planning exercise should be made public.

4.3 Meeting the challenge of agricultural demand through solar feeders

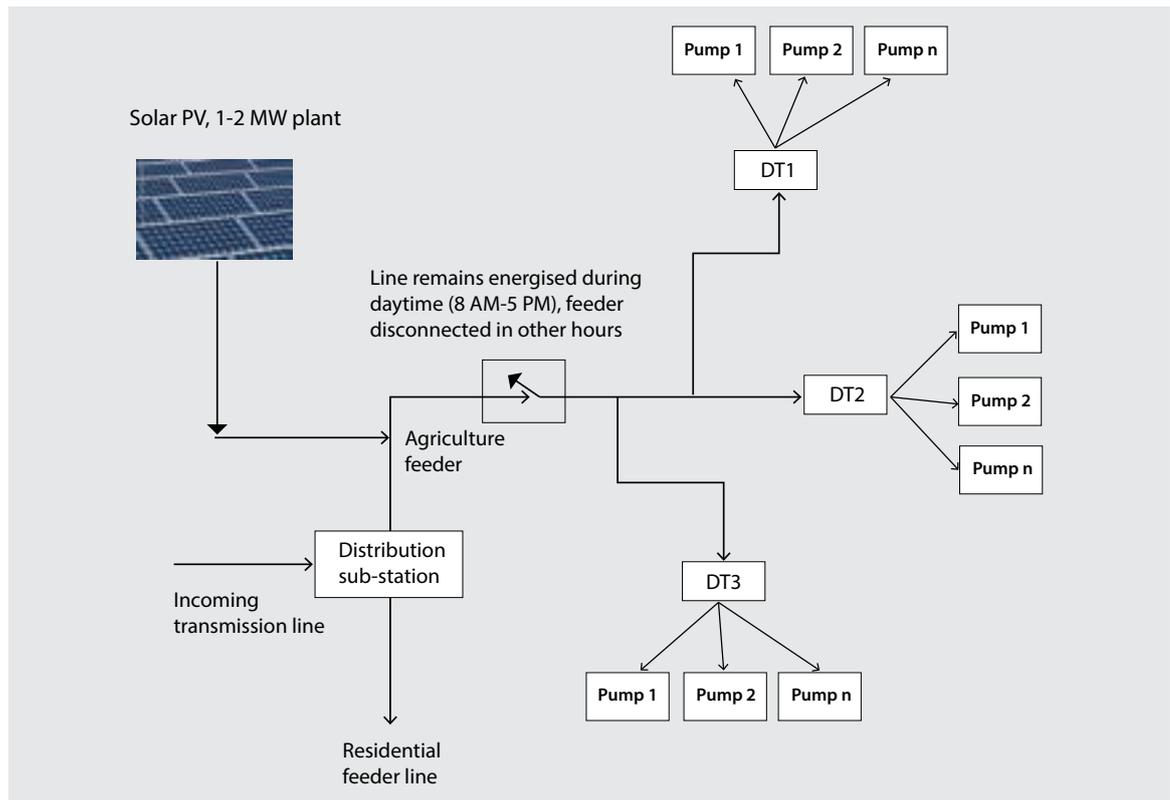
Agriculture accounts for almost 20%–30% of the total sales in many states, although the demand hardly generates any revenue, leaving DISCOMs heavily dependent on subsidy and cross subsidy. Unmetered consumption for agriculture remains a permanent feature of the state power sector; is an inherent aspect of the power sector's political economy; and is also deeply connected with both financial and distribution losses of DISCOMs. To address the problem of supplying electricity to agriculture, DISCOMs have tried such measures as feeder separation to curtail demand. Feeder separation is also recommended by the central government for managing agricultural demand, and the DDUGJY has earmarked more than Rs. 24,000 crore¹⁶ for its implementation across states (MoP, 2014, p. 6). Hence, any efforts to reduce the liabilities of DISCOMs need to include strategies to overcome the challenge of supplying electricity for agriculture.

Solar power – now that it is becoming cheaper – can be used to effectively cater to agricultural load in states where feeder separation has already been accomplished because it would achieve the twin objectives of reducing costs and subsidies and improving consumer satisfaction by offering to supply electricity to farmers not only during daytime but also reliably. Figure 8 shows how this idea can be implemented. A 1–2 MW tail-end solar PV plant (representative of a typical agricultural feeder load) is connected to a 33 kV substation and the feeder is kept live or free of load shedding during daytime (from 8 a.m. to 5 p.m., for example) primarily for meeting agricultural load. If the agricultural load is high, the grid makes up the difference; if the generation exceeds the demand, power from the solar plant flows back to the local grid.

16. This amount has been earmarked for feeder separation and associated works for 16,500 feeders.

Assuming that 1) an 11 kV agricultural feeder has 500 pumps of 5 hp each connected to it; 2) the pumps run on average for 1200 hours a year; 3) the losses in the 11 kV and LT line are 6%; 4) the energy price of solar PV at the 11 kV level is Rs. 3.25/kWh and fixed for at least 20 years; and 5) the cost of conventional grid supply (assuming average cost of power purchase at Rs. 3.50/kWh) increases by 2.5% a year, the savings, i.e. reduction in cost of supply for one such solar feeder would be about Rs. 4.5 crore in nominal terms and Rs. 1.3 crore in terms of the net present value (NPV) over 20 years.¹⁷ This demonstrates that using solar feeder can significantly lower the cost of supplying to agricultural load and, consequently, lead to lower subsidies for agricultural sales. This would be achieved without any additional capital subsidy.

Figure 8: Solar-powered agricultural feeder system



Source: Prayas (Energy Group).

A preliminary analysis suggests that the set-up shown in Figure 8 is significantly more cost-effective than installing a solar pump at every individual point of use (i.e. for every pump). Further, the growing price competitiveness of such an approach is underscored by the latest price discovery for utility-scale solar projects. Considering the fixed cost of solar generation (over 25 years) and the increasing cost of conventional grid supply, an integrated solar-powered feeder with efficient pumps would be cheaper than grid supply and substantially reduce the DISCOM's subsidy and cross-subsidy requirements and yet allow the DISCOM to fulfil the mandated solar purchase obligation (to be 8% by 2019 as per the Tariff Policy) and to provide electricity during daytime to agricultural consumers.¹⁸ Maharashtra has already announced plans to implement such schemes¹⁹, and other states are likely to follow.

17. The cost of distribution, being the same in both scenarios, is not considered in this analysis.

18. T L Sankar had proposed a graded system back in 2002 for allocating available generation capacity fairly and equitably. Under his proposed scheme, the least-cost generation was to be used to meet agricultural and other socially relevant demands; the demand of other small or subsidised consumers was to be met from the pooled power of utilities; and the emerging large demand, mostly of industrial and commercial consumers, was to be met by new private, public, or captive power stations through mutually agreed commercial contracts (Sankar, 2002).

19. For more details see this news article in the Times of India <https://timesofindia.indiatimes.com/city/nagpur/govt-plans-to-supply-solar-power-to-40l-farmers-in-10-yrs/articleshow/62074017.cms>

The three steps outlined above, namely 1) moving to long-term open access and make such consumers responsible for planning their own power procurement, 2) avoiding signing new baseload capacity PPAs by DISCOMs, and 3) solarizing agricultural feeders to provide daytime power to agricultural consumers and to reduce the burden of agricultural subsidies borne currently by DISCOMs and state governments, would enable DISCOMs to avoid risks of stranded assets, suboptimal use of capacity, and increasing costs. This can be seen as a nimble and flexible approach to managing an uncertain future.

It could be tempting to believe that the separation of carriage and content suggested by the central government in the form of the proposed Electricity (Amendment) Bill, 2014, could achieve the same objectives. As highlighted in Box 1, this is not the case.

Box 1: Is the proposal in Electricity (Amendment) Bill, 2014 a possible solution?

In 2014, the central government introduced the Electricity (Amendment) Bill, 2014, in the parliament. Amongst the various changes proposed in the amendment, the major thrust seemed to be on a) introducing the separation of carriage and content, i.e. segregation of the wires business and the supply business, b) encouraging open access, competition, and markets, c) giving more impetus to renewable energy, and d) ensuring greater accountability of the regulatory institutions. Given such thrust areas, it is possible to imagine that the amendment, if brought into effect, will lead to changes similar to those that are proposed in this paper. To examine this contention, let us understand the changes being proposed in the amendment and see how they differ from the solutions proposed in this paper.

According to the version tabled in the parliament in 2014, each area of distribution (at present, many states have multiple distribution licensees) will have a single distribution licensee who is responsible for wires and metering and multiple supply licensees who are responsible for supply and billing. To make this change, the state government, in consultation with the central government, will have to implement a transfer scheme and create an intermediary company, a wires company and one or more incumbent supply licensees. Other supply companies can also apply for a license to supply in this area. The central government will specify the functions of the intermediary company in which will be vested all the existing power-purchase contracts. The universal supply obligation (USO) will rest with the incumbent supply licensees, and the subsequent supply licensees will have the obligation to supply, based on a load factor to be prescribed by the central government. Therefore, the incumbent licensee will be the one most affected financially on account of the migration of high-paying consumers to new supply licensees and to open access.

The most challenging aspects of this proposed change are the reallocation of existing power-purchase contracts and decisions on the role and functions of the intermediary company, in which all existing power-purchase contracts are to be vested. It is unlikely that these negotiations will be straightforward, because the state-owned supply licensee will face the most adverse financial consequences of this change and hence the centre's and the state's perspectives on these issues are likely to have little overlap. It is important to note that to formalise the unbundling of state electricity boards, even the prevailing 2003 act mandated the state governments to notify a similar transfer scheme, which so far no state except Gujarat has implemented.

The second problematic aspect of the proposed amendment is the imposition of the responsibility to meet the USO on the incumbent supply licensees. Shouldering this responsibility requires the incumbent supply licensee to plan its power purchase keeping in mind this larger role and hence poses the threat of bringing back all the ills of present power procurement practices. More

important, such a mechanism will impose the burden of such inefficient power procurement on the small and regulated consumers of the incumbent supply licensees.

The scheme proposed in this paper differs from the above in recommending regulatory and process changes that can be easily implemented within the existing legal framework and which will lead to similar desirable outcomes, namely greater competition and choice for consumers.

The changes proposed in this paper prevent DISCOMs from adding any new unwanted baseload capacity by channelizing future capacity addition through long-term open access and by creating investments in capacity addition through market-based instruments. The role of the DISCOM in this scheme is that of the provider of last resort, which is a much more limited role than that of ensuring the USO and hence can be fulfilled without the DISCOM having to add huge new capacity. This approach restricts the DISCOM's liabilities and hence its losses.

To sum up, it may seem that separation of carriage from content will lead to greater competition by increasing consumer choice and by limiting a DISCOM's losses; however, such an outcome is unlikely if such a separation is brought about by the means proposed in the 2014 amendment.

4.4 Re-thinking tariff design in the context of changing cross-subsidy scenario

The cost-plus approach provides little incentive to improve efficiency, and prudence checks often end up being merely accounting exercises in the absence of benchmarking of crucial performance parameters and independent, third-party evaluation of major expenses. Such inefficiencies inflate costs and necessitate greater subsidy to ensure affordable supply for small consumers. Some states impose minimum consumption charges, which discourage efficient consumption and in fact penalises consumers already suffering from power shortages. In some states such as Uttar Pradesh, tariff for unmetered consumers is lower than that for metered consumers in the same category, which discourages those who seek metered connections. Many states have different tariffs for rural and urban consumers within the same consumer category. Thus, tariff design changes offer many opportunities for improvement and rationalization to make it less complex. Such improvements will not only help consumers but also make it easier for DISCOMs to recover their costs. In a changing scenario of utility finances, it is imperative to protect small consumers from price shocks. It is against this background that some suggestions are presented here to deal with a gamut of problems related to tariff design.

4.4.1 Moving away from cost-plus regulation

As discussed earlier, a great deal of inefficiency in the sector today is on account of the cost-plus approach to tariff regulation. Although most states have notified multi-year tariff (MYT) regulations, none has implemented them to ensure price and cost certainty for consumers and DISCOMs or to prod DISCOMs into operating more efficiently. As a DISCOM's consumer base begins to shrink and avenues for subsidy and cross subsidy begin to close, it will be important to reduce costs. To this end, it is imperative to move away from the cost-plus approach and explore instead other methods such as benchmark-based regulation or price caps or revenue caps. Moving away from the cost-plus regulation sends a clear signal that inefficiencies need to be curtailed and also allows SERCs more time to focus on important measures such as reducing losses, monitoring markets, and enforcing compliance with the norms for supply and service quality.

4.4.2 Tariff rationalization for low-tension consumers

4.4.2.1 Inflation-linked tariff increase

To meet their burgeoning costs, DISCOMs need a credible and consistent mechanism to increase tariffs periodically, at least to keep pace with inflation. To ensure such periodic revisions in tariffs for a large section of a DISCOM's consumer base, SERCs can link the tariffs for small, retail consumers (for example, the general category LT consumers, which is mentioned below) to the rate of inflation or perhaps plus or minus 1%–2% of that rate. The regulations can be amended to allow the tariff for such consumers to be revised automatically at the beginning of every financial year based on the previous year's inflation index. The charges and the escalation in tariffs should be fixed for a MYT period and should not include adjustments for fuel charges or any other additional charges. If such additional charges are included, there would be no price certainty for these consumers. After a given MYT period, the tariff design and the charges can be re-assessed and re-determined. Such programmed tariff revision can provide the much-needed tariff certainty for small consumers and assured revenues to DISCOMs.

4.4.2.2 Equitable tariff design for small consumers

In many states, small commercial and industrial consumers are charged tariffs comparable to those for HT consumers, forcing small enterprises operating from homes to use a domestic connection, making them liable to be charged with unauthorised use of electricity.²⁰ In order to ensure hassle-free and affordable supply to such small consumers while maintaining revenue neutrality for the DISCOM, SERCs can recommend the following measures.

- Fix a uniform tariff for all LT domestic, commercial, and industrial consumers with a connected load of less than 10 kW and monthly consumption up to 300 kWh. Such tariff design can enable home-based enterprises to run their business without a separate connection and will also protect them from any opportunistic interpretation of Section 126 pertaining to unauthorised use of electricity.
- Make the tariffs within the above category telescopic, i.e. the lowest slab enjoys the lowest charges whereas the highest slab faces the highest charges. However, these slabs as well as the tariffs should be uniform across these LT categories. For consumption above 300 kWh, the tariff slabs as well the tariffs can vary across categories.
- Charge high tariffs for consumption greater than 300 kWh a month so that the proposal is revenue neutral for the DISCOM. This would ensure some degree of intra-category cross subsidisation and incentivise efficient use of electricity.

Such a tariff system would encourage consumers to choose the type of connection based on use and ensure that requisite information on billing, sales, and revenue collection is available. Table 3 illustrates such a tariff design for LT consumers with a connected load less than 10 kW. Apart from simplifying tariff design significantly, such a general LT category would prevent harassment of consumers on account of the so-called 'unauthorised use' of electricity, as the tariff would be the same for residential and non-residential consumers.

On similar lines, Maharashtra has implemented a tariff design that allows consumers "*whose monthly consumption is up to 300 units a month and annual consumption in the previous financial year was up*

20. Section 126 deals with unauthorised use of electricity and Section 135 deals with theft of electricity. Currently, even Section 135 uses the term 'unauthorised use'. Section 135(1)(e) states that any consumer using electricity for the purpose other than for which the usage of electricity was authorised could be booked for theft of electricity. This gives the inspecting officer the discretion to book a Section 126 case under Section 135. The penalty clauses under section 135 are far more stringent, and hence there is a danger of its misuse to harass consumers who are not indulging in theft but can be held guilty only of unauthorised use, for which the penalty is significantly low.

to 3600 units” to pursue “business or commercial, industrial, or non-residential activities from a part of their residence”. The applicability of this tariff is assessed at the end of each financial year and if consumption in the previous year is more than 3600 kWh, the consumer is no longer eligible thereafter for the tariff under the lower category and will be charged the tariff otherwise applicable for the kind of consumption (MERC, 2016, p. 431).

Table 3: Illustrative tariff design for a general category of low-tension consumers

Slab for monthly consumption (kWh)	Average tariff (Rs/kWh) in a typical tariff design			Average tariff (Rs/kWh) under the proposed LT general category		
	Domestic	Commercial	Industrial	Domestic	Commercial	Industrial
0–100	3.5	9.5	8.5	3.5	3.5	3.5
101–200	4.5			4.5	4.5	
201–300	5.5			5.5	5.5	
300–500	6.5			7	7	
>500	7			9	9.5	8.5

Source: Prayas (Energy Group).

4.5 Developing robust markets

One of the goals for managing this transition is to move towards a distribution sector in which most consumers can choose their supplier, and decisions regarding future capacity addition are taken based on market-based mechanisms. However, if this goal is to be achieved, there is an urgent need to develop robust markets, which can:

- manage demand uncertainty efficiently by giving appropriate signals for capacity addition and load management
- facilitate smooth integration of variable generation sources with the grid in an economically and commercially feasible manner
- improve grid stability and reliability by providing ancillary services, which include load regulation, spinning and non-spinning reserves, reactive power support, etc.

At present, the power sector market is fragmented and does not have enough instruments to play these dynamic roles. A capacity market is virtually non-existent, and most of the baseload capacity is added through long-term cost-plus contracts signed by DISCOMs. Medium-term trade is conducted through competitive bidding by DISCOMs, bilateral traders, or through the DEEP portal without much flexibility in the duration of the contract or lead time. Short-term trade is also conducted based on bilateral contracts in a non-transparent manner at rates mutually agreed upon. Currently, a single-price, closed-auction market exists only in the form of power exchanges for day-ahead trade: automated and transparent platforms such as power exchanges do not have instruments for trade for longer than a week.²¹ The markets are also fragmented owing to transmission constraints and information asymmetries. The short-term intra-state markets, are quite opaque with almost no data on these transactions being available in the public domain. All these factors hardly incentivise market innovation.

Better market mechanisms are also needed for efficient re-allocation of contracted capacity through sale of surplus power and provision of competitive supply options for migrating consumers. If states

21. There has been an ongoing dispute between the Forward Markets Commission (FMC) and the Central Electricity Regulatory Commission regarding jurisdiction over forward or futures trading in power. However, independent of this legal issue, trading platforms such as exchanges can offer various instruments for enabling trade over longer durations. The suggestion in this paper is in this context and not regarding forward or futures trading in power.

fail to develop open and transparent markets that cater to the increasingly complex demands of the sector, informal market instruments will flourish to fill the space. These unregulated markets could lead to many gaming possibilities, and the DISCOM, as the provider of last resort, may have to bear the ultimate burden. New (and possibly unregulated) players such as supply aggregators for open-access or captive-power consumers and storage providers are also likely to enter the market. Therefore, urgent steps should be taken to facilitate robust market development, and some suggestions to hasten such development are offered here.

4.5.1 Innovation in designing power procurement contracts

With both supply and demand being increasingly variable, DISCOMs should be discouraged from procuring power on round the clock (RTC) basis, especially in the short-term. With high intake of renewable energy sources and changes in load curves due to sales migration, RTC contracts need not be the norm, as they have been for the past decades. Instead, flexible and innovative ways are needed to structure contracts to match the variations in demand. In the past, DISCOMs had the option of procuring peak, off-peak, and seasonal contracts through short-term, medium-term, or long-term competitive bidding as well. However, due to lack of interest among bidders and lack of adequate efforts by DISCOMs, the option was not exercised fruitfully (PEG, 2017). In the present situation of surplus power, proliferation of generators in the recent past, and the possibility of transparent medium- or short-term trades on the DEEP platform, it should be easier for DISCOMs to match the variations in demand with a mix of power procurement strategies. For this purpose, DISCOMs should be compelled to undertake a more detailed analysis of their load patterns and procure power accordingly. Such procurement may also create opportunities for using some of the stranded capacity at the national level for managing seasonal variability and peak demand.

4.5.2 More flexible instruments to aid procurement decisions

With the inherent variability of renewable-energy-based supply options and the increasing demand uncertainty of DISCOMs, a high degree of flexibility is needed in managing and regulating the sector; to provide DISCOMs and large consumers with multiple options to meet their requirements, different types of market instruments are required as well. Appropriate instruments and a regulatory environment that fosters market development can reduce the risk from flexible procurement and can spur innovative business models using a mix of options such as grid-level storage, demand response, demand aggregation, and hybrid wind-solar projects. For example, participants in power markets need long-term power contracts in which the price is determined through a transparent, market-based process. However, currently the DEEP platform can be used only by DISCOMs: open-access or captive-power consumers are not allowed to participate. This needs to be changed. Similarly, power exchanges can allowed trade for 3 hour to 11 day durations with the possibility of intra-day, daily, and weekly contracts. A policy push is needed to ensure legal and jurisdictional clarity to promote the development of month-long and year-long contracts through power exchanges.

4.5.3 Facilitating development of capacity markets

With the persistent surplus, the intermittent nature of renewable energy, and the need for non-RTC contracts, India needs to develop transparent capacity markets. An environment in which generators are willing to bear the risk of building capacity for the market rather than for a long-term PPA with the DISCOM needs to be facilitated. To initiate such a process, longer-duration contracts can be allowed on power exchanges; generators and open access consumers can be encouraged to participate on such platforms as the DEEP; and seasonal instruments and fixed-payment-capacity contracts also need to be encouraged. Capacity investment via market mechanisms also requires a level playing field in the fuel sector. There is a need to de-link long-term PPAs with DISCOMs from coal allocation as it is a strong deterrent for merchant capacity to operate. Recent policies such as SHAKTI, however mandate long-term PPAs with DISCOMs as a condition for coal allocation and thus need to be revised (PEG, 2017).

4.5.4 Developing institutional capacity for regulating and monitoring markets

Markets, especially in their nascent stage, require a sound governance framework and institutional capacity for monitoring their operations to transition to dynamic markets. Such market monitoring mechanisms also need to be agile so that mid-course corrections can be made quickly and effectively if and when necessary. This is an area with huge scope for improvement, because regulatory institutions in India have so far never demonstrated much capacity or the wherewithal to play this crucial role. Thus, there is an urgent need to invest in and develop such institutional capacity as would be needed to regulate and monitor market operations effectively.

The Central Electricity Regulatory Commission and the Forum of Regulators have taken many positive steps to facilitate, regulate, and monitor the operations of electricity markets: the CERC has been publishing market monitoring reports that keep a track of trends in interstate short-term trades, and the forum has constituted working groups and drafted model regulations to provide clarity on many topics pertaining to market operations. However, as of today, no SERC issues similar reports that monitor intra-state short-term trades. The Central Electricity Regulatory Commission has also initiated efforts to introduce regulations on ancillary markets and to launch a national open-access registry to create an integrated platform to facilitate single-window clearance of open-access transactions. Such a move can go a long way in addressing procedural hassles and process-related issues faced by market participants and the operationalizing entities. However, given the rapid pace of changes in the sector, more efforts are required at the national level and also at the state level for effective market development.

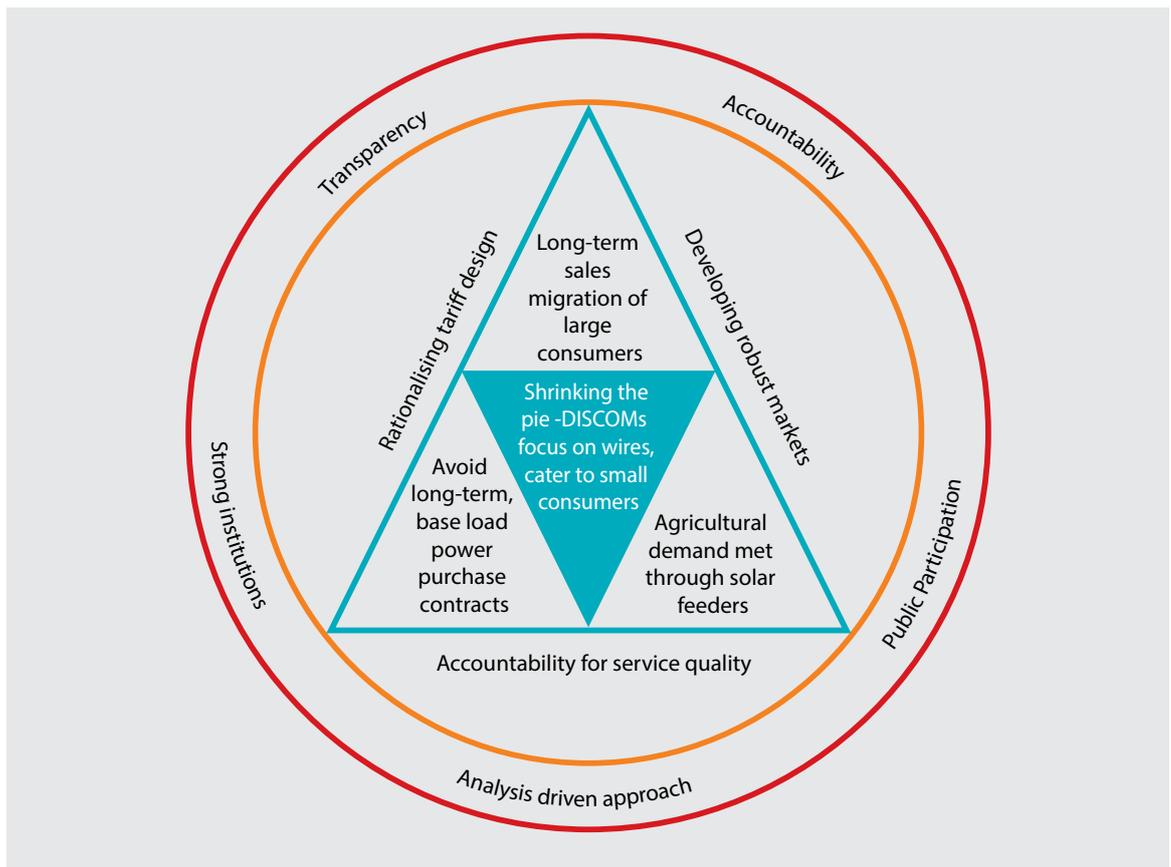
If the existing capacity is to be used efficiently, especially, with significant open access and captive consumption, and if future capacity addition is to be responsive to demand, a transition to capacity addition through market-based instruments is necessary. Given the existing surplus, commitment to renewable energy capacity addition, and increasing sales migration, India is for the first time in a position to develop such markets. Markets, where generators are willing to bear the risk of adding capacity to cater to market demand rather than to DISCOM demand, will develop only with innovative instruments, agile planning, long-term market development, delinking of fuel supply from DISCOM demand, and increased monitoring of electricity markets. Given the economic advantage and the dearth of instruments, new players to aggregate demand, provide storage options, etc. would inevitably emerge. If these developments are not appropriately accounted and planned for, the result would be suboptimal outcomes and gaming possibilities.

4.6 Accountability for supply and service quality

With surplus power and significant progress in electrification, the next major challenge is to ensure good quality of supply and service. The government has already announced ambitious plans such as '24 x 7 Power for All', but achieving this goal will need significant effort, especially from DISCOMs and SERCs. Owing to revenue considerations, DISCOMs may be unwilling to supply to rural and newly electrified households. It is also important to understand that there is a huge trust deficit between DISCOMs and small consumers regarding metering, billing, and service quality, which needs to be addressed first. As discussed above, the cross-subsidy-dependent approach to keeping tariffs low for small consumers is unlikely to work in the future. This would imply significant tariff rebalancing. For such rebalancing and to reduce politicization of tariff revisions, it is essential to address the trust deficit between consumers and DISCOMs and to ensure good quality of supply. Any efforts at tariff rebalancing without improving supply quality are likely to fail or lead to significant political implications. In this regard, the following measures can be implemented by SERCs to improve supply and service quality.

- Monitoring actual supply hours:** Technology can be used effectively to monitor the actual hours of supply. Many schemes are ongoing to undertake metering at the feeder level and at the distribution-transformer level. Using latest technology, regulators can mandate DISCOMs to make interface metering fully automatic and to make the data publicly available to make DISCOMs more accountable. The National Power Portal Dashboard has been providing information for every DISCOM on the number of interruptions and their durations. The information for urban areas is reported based on the URJA app which captures data for 1300-1400 urban towns covered under IPDS/ R-APDRP. The portal also provides data on average hours of supply for over 10,000 rural feeders. Provision of such information is a significant step towards greater transparency and accountability for quality of supply. However, the accuracy and reliability of this data and its representation need to be established. For example, the total duration of interruptions (in seconds) reported annually for Pune, Hyderabad and Lucknow was much more than the number of seconds in a year. The same dataset 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. Thus, Pune lost more hours of supply than Akola, Hyderabad lost more than Medak, Chennai lost more than Dharmapuri, Bangalore lost more than Harpanahalli, Kochi lost more than Kasargod, Baroda lost more than Umreth and Lucknow lost more than Sitapur. In addition to this initiative, independent monitoring of supply reliability as demonstrated by initiatives such as the Electricity Supply Monitoring Initiative can also play a crucial role in making data on actual supply publicly available in a meaningful and accessible form and should be encouraged.
- Metering and billing:** There is enormous scope to improve metering and billing on the consumer side. Again, technology and transparency can play a significant role in improving service quality and reducing consumer grievances. Some DISCOMs have already launched apps that allow consumers to register complaints and track their status. Such systems can be substantially improved to enable faster resolution of grievances. Additionally, SERCs can institutionalise third-party audits of metering, billing, and supply quality, which can significantly improve internal systems of the DISCOM responsible for managing these operations.
- Public hearings on supply and service quality issues:** With increasing electrification and the predominant consumer base of DISCOMs shifting to small, retail consumers, SERCs need to be more proactive in prodding DISCOMs to ensure good quality of supply and service. Historically, compliance with standards of performance by DISCOMs has been poor and this needs to change urgently. The (E Act) 2003 (Section 59) allows for public scrutiny of a DISCOM's compliance with standards of performance set by the SERC; however, most states do not undertake such a public process. The state electricity regulatory commissions should institutionalise such public reviews of compliance with service quality norms.
- Harnessing technology to improve efficiency:** With most states undertaking feeder- and distribution-transformer-level metering, SERCs should insist on data-based commercial settlements, e.g. using data from agricultural feeders to estimate agricultural sales. With the proliferation of players in the generation sector, regulatory challenges will also multiply. Use of sophisticated metering infrastructure will be crucial to monitoring transactions of open-access and captive-power consumers. Further, to improve accountability, SERCs should publish real-time data on supply quality in the public domain. Having such data publicly available will also improve reliability and accuracy of regulatory decisions and will contribute to making both DISCOMs and regulators more accountable and in building a better-informed public debate on issues related to this sector.

Figure 9: Schematic representation of the suggested approach



Source: Prayas (Energy Group).

To summarise, the overall approach discussed above is represented in the schematic in Figure 9. As shown in the figure, for any effective transition, efforts to ensure strong institutions and transparent, participative processes are also imperative.

5. Conclusions

The analysis and trends discussed in this paper suggest that the DISCOM of the future will be mostly a supplier to LT consumers and a wires utility for HT and LT consumers. Such a transition demands a major shift away from the manner in which DISCOMs have been planning and operating in the past. Markets and competition will have a substantial role to play in this transition. Unless guided by conscious policy decisions, these changes will unfold chaotically, leaving the DISCOMs stranded with excess capacity and huge losses—and the sufferers of such a fallout will be mostly small and rural consumers with serious implications for state level politics. To avoid such consequences, it is extremely important to intervene now and to guide the inevitable transition in a manner that enables DISCOMs to adapt to the fast-changing realities of the sector. The impending changes can be turned into opportunities only if DISCOMs, regulators, and policymakers begin acting at the earliest to turn the changes into opportunities.

It is important to reiterate that the ideas and suggestions proposed here will not directly tackle chronic problems that plague the sector, such as accumulated losses of DISCOMs and the issue of stressed assets. Separate bail-out schemes such as UDAY will be needed to tackle these problems. Also, even if consumer migration takes place as per the scheme proposed above, there will yet be a need for transition finance from the state and central governments. These are not the issues that the proposed scheme can resolve directly; instead, the proposed scheme will achieve the following objectives.

- A less-disruptive transition as high-paying consumers migrate away from DISCOMs
- Minimal stranded assets by avoiding any new conventional, baseload power contracts by DISCOMs
- Provision of space for meaningful and orderly changes in the political economy of the sector (for example, moving away from cross-subsidy-based model and improving the quality of supply to agricultural consumers while limiting subsidy requirements)
- Protection of the interests of small and marginalised consumers, who may otherwise suffer most on account of the transition in terms of higher tariffs and poor supply quality
- Greater public accountability through technology for improving the performance of the wires business and supply quality
- Greater transparency and accountability and meaningful public participation in addressing 'governance deficit'

This paper highlights some key challenges before the sector and potential approaches to overcoming them. These approaches may need to be spelt out in greater detail and improved upon after further deliberations, but unless the issues and trends discussed here are addressed in a proactive and coordinated manner, the uncertain future – and the transition to it – will be far more painful.

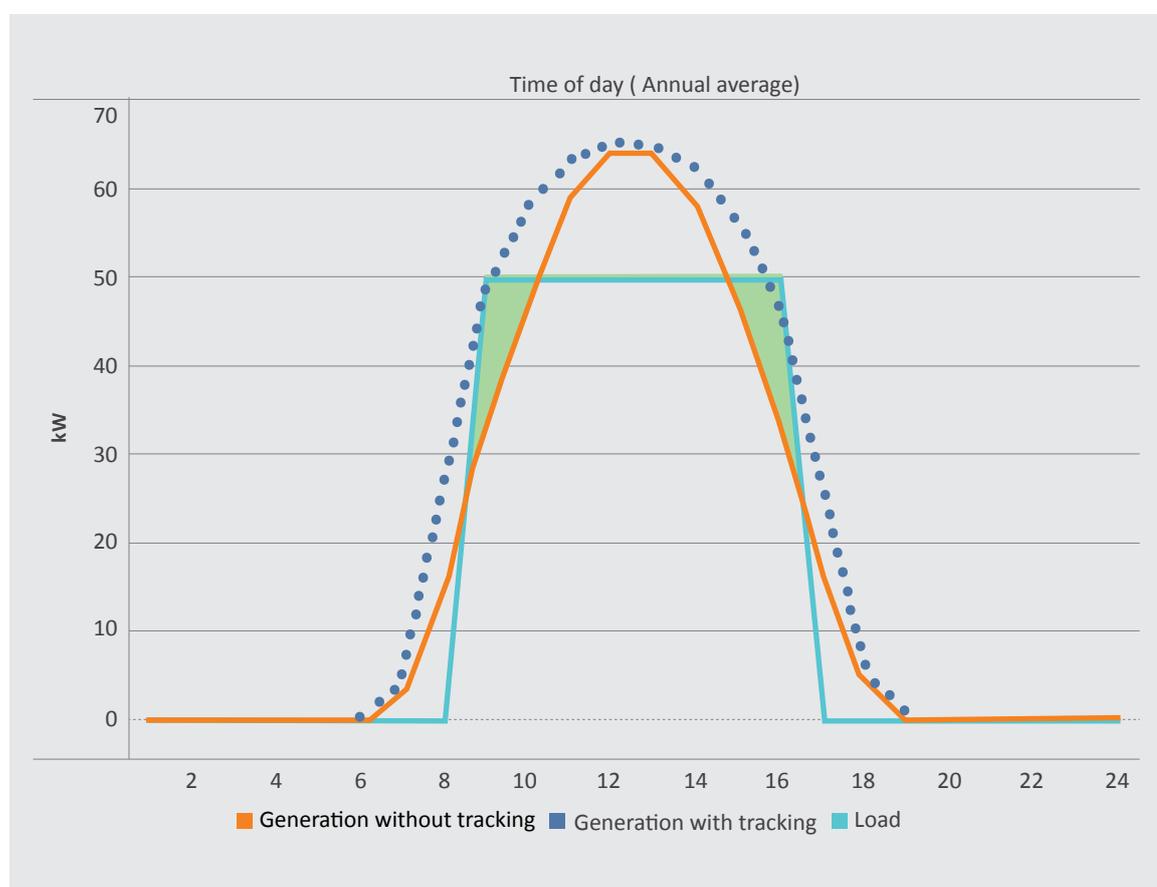
Annexure 1:

Solar plus storage as a supply option

Given the rapidly falling prices of battery storage, an oversized solar PV system with storage can help overcome the twin challenges of variability and the diurnal nature of solar generation. As shown in Figure 10, a consumer with a predominantly daytime load may opt for an oversized solar system and use the excess to charge a battery. The stored energy can then be used to meet the demand for a few additional hours (depending on the size of the battery) or to meet any load-generation mismatch, even if partially.

Let us assume that an appropriately oversized grid-connected solar system is designed to cater to the energy needs of a captive industrial consumer with a total demand of 50 kW, constant for 10 hours, i.e. 500 kWh. Further, assuming that (a) there are no net metering arrangements nor is the excess solar energy being fed into the grid, the price of solar generation from the system is Rs. 3.4/kWh, and (b) the consumer has a weekly holiday so that all the solar energy produced on that day is 'wasted', the effective price of solar energy works out to Rs. 4/kWh. With an oversized system and the present storage cost of approximately Rs. 12/kWh, the total cost of electricity from such a solar-PV-system with storage would be Rs. 7.6/kWh, assuming that 70% of the energy requirements are directly met through the solar PV system and 30% through the battery pack.

Figure 10: Using oversized solar PV system with storage



Source: Prayas (Energy Group) analysis.

These storage costs are for an electric lithium-ion battery pack, sized such that roughly 30% of the consumer load is met from the battery. The capital cost for the battery is assumed at \$300/kWh and the exchange rate, at Rs. 65 per dollar. For the battery pack, the energy loss is considered at 8%, the depth of discharge at 87.5%, and the battery life is taken as 5000 cycles. The interest rate on the capital cost is taken as 8%; annual O&M costs, as 1% of capital cost; and the levelised tariff for storage is estimated assuming a 10% discount rate.

In 3–5 years, with improvements in technology and reduction in costs, the storage costs could be expected to be as low as Rs. 7–8/kWh, assuming future storage cost at \$190/kWh based on the estimate for 2020 (McKinsey & Co., 2017) and the exchange rate as Rs. 67–70 per dollar based on the long-term inflation differential between India and USA. This would reduce the electricity cost to consumer to Rs. 6.5/kWh, which is lower than current average cost of supply incurred by most DISCOMs. Again, this cost would be roughly constant for 20 years, while the cost of supply from DISCOMs is bound to increase.

Thus, significantly reducing their grid offtake would be economically very attractive for consumers with a predominantly daytime demand, the only constraint being space availability for solar systems.

Abbreviations

ACOS	Average Cost of Supply	kWh	Kilowatt hour
AT&C	Aggregate Technical and Commercial	LT	Low Tension
BPL	Below Poverty Line	MERC	Maharashtra Electricity Regulatory Commission
CAGR	Compound Annual Growth Rate	MoP	Ministry of Power
CEA	Central Electricity Authority	MU	Million Units
CERC	Central Electricity Regulatory Commission	MW	Mega Watt
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana	MYT	Multi Year Tariff
DEEP	Discovery of Efficient Electricity Price	O&M	Operation and Maintenance
DISCOM	Distribution Company	PLF	Plant Load Factor
DSM	Demand Side Management	PPA	Power Purchase Agreement
DT	Distribution Transformer	PV	Photovoltaic
E Act, 2003	Electricity Act, 2003	R-APDRP	Restructured Accelerated Power Development and Reforms Programme
ERC	Electricity Regulatory Commission	RE	Renewable Energy
EV	Electric Vehicles	RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
FRP	Financial Restructuring Plan	RPO	Renewable Purchase Obligation
GW	Giga Watt	RTC	Round The Clock
HT	High Tension	SAUBHAGYA	Pradhan Mantri Sahaj Bijli Har Ghar Yojana
hp	horsepower	SERC	State Electricity Regulatory Commission
IDC	Interest During Construction	SHAKTI	Scheme for Harnessing and Allocating Koyla Trasperently in India
IPDS	Integrated Power Development Scheme	T&D	Transmission and Distribution
kV	Kilovolt	UDAY	Ujwal Discom Assurance Yojana
kW	Kilowatt		

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Electricity distribution sector is at a cross-road, with rising cost of supply, emergence of competitive renewable supply options, loss of cross-subsidising sales, and sustained high-cost base-load surplus. At the same time, the age old challenges of high transmission and distribution losses, poor quality of supply and service, and burgeoning financial losses persist. This implies that there will be significant demand uncertainty for distribution companies, making power purchase planning more complex and riskier. Also, the traditional model of cross-subsidy based tariff design is unsustainable.

Unless guided by conscious policy decisions, these changes will unfold chaotically, leaving the distribution companies stranded with excess capacity and huge losses—and the sufferers of such a fallout will be mostly small and rural consumers with serious implications for state level politics. To avoid such consequences, it is extremely important to intervene at the earliest. The impending changes can be turned into opportunities only if distribution companies, regulators, and policymakers begin acting at the earliest. This discussion paper suggests an approach and some concrete measures to enable a smoother transition for the sector and especially, for the small consumers.