

DISTRIBUTION REFORMS IN THE TRANSITION TO A SUSTAINABLE ENERGY PATH

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The Electricity Act of 2003 (EA 2003) has been instrumental in driving reforms such as promoting competition, multi-year tariff frameworks, de-licensing generation, renewable purchase obligations and independent regulatory bodies to govern the power sector. These reforms have been pivotal in reducing power shortages, ensuring near universal grid access and increasing the share of renewable energy (Ministry of Power, *n.d.*). While the electricity generation and transmission sectors have benefitted from these structural reforms, the distribution sector continues to be burdened by myriad financial, technical and governance challenges. Most DISCOMs (electricity distribution companies) continue to incur substantial financial losses, accumulate debt and struggle to provide reliable, high-quality power to consumers (Bali et al., 2020).

INTRODUCTION

The government has undertaken numerous initiatives to support the distribution sector, recognising its persistent struggle to improve its financial and operational performance. Besides the structural reforms of 2003, DISCOMs have received four major financial restructuring or bailout packages since 2001, including the UDAY scheme (Ujwal DISCOM Assurance Yojana) in 2015, each contingent on conditions aimed at improving operational performance. Despite these efforts, the liabilities have continued to rise, approaching 2 per cent of India's GDP. The UDAY scheme aimed to transfer DISCOMs' mounting liabilities, owed to commercial banks and other lenders, to

state governments hoping that liquidity injection would reduce debt burden and improve operational efficiency. However, the overall operational performance did not improve and losses have remained significant for most DISCOMs (Raghavan and Sasi, 2019). Apart from addressing past losses, the governments also provided significant subsidies to ensure the financial viability and efficient operation of DISCOMs. The fiscal distress of state-owned DISCOMs, which handle about 80 per cent of India's electricity demand, may be gauged by their cumulative debt of ₹6.84 lakh crore and accumulated losses of ₹6.46 lakh crore (Jai, 2024). The sector's aggregate technical and commercial (AT&C) losses were recorded at 17.6 per cent in FY2024, following a brief period of improvement, according to estimates from the Ministry of Power.¹

Privatisation of DISCOMs is proposed as a solution to improving their performance, although it has also yielded mixed results. The partial success of distribution privatisation is largely witnessed when risks are mitigated through favourable geographical areas, particularly well-governed urban regions, substantial financial incentives, strong political backing and consistent regulatory oversight. It is, therefore, crucial to understand the challenges faced by the distribution sector and the reasons why reforms and proposed solutions have not been effective.

It can be argued that the challenges faced by the distribution sector are deeply rooted in its technical, structural, governance and socio-political complexities, extending beyond issues of public-private ownership, poor scheme execution and inefficient public sector governance. The sector operates in a complex and multifaceted risk landscape, grappling with demand uncertainties, socio-political pressures and systemic inefficiency, with at least some of them beyond the control of distribution companies. As a result, it is disproportionately burdened within the power sector value chain, serving as the endpoint for concentration of risks and effectively derisking the transmission and generation sectors.

This paper discusses the role of distribution utilities in India's sustainable energy pathways and the structural changes needed to achieve the same. It cites selective evidence from distribution utilities across different states, with the assumption

that the arguments and evidence presented are likely to apply to most under-performing distribution utilities.

WHAT PLAGUES THE DISTRIBUTION SECTOR?

The power sector is exposed to a plethora of market and non-market risks. The former includes volatility in international and domestic fuel prices, liquidity constraints and delay in payments, foreign exchange risks and under-developed markets. Policy and regulatory uncertainty, poor compliance and weak institutions, natural disasters and climate change, along with transition complexities are common non-market risks that plague the sector.

Within the power sector, state-owned electricity utilities (SOEUs) perform poorly in comparison to their counterparts that are owned by the central government or the private sector. At the state level, electricity distribution utilities often fare poorly even in comparison to transmission and generation companies owned by respective state governments. Many authors and experts have written about the challenges of distribution companies, and their synthesis can be broadly classified into three categories: i. Operational and technical issues such as high transmission and distribution losses, poor HT-LT ratio,² poor metering at various levels, revenue recovery, and overall poor management; ii. Commercial and financial reasons such as high cost of power procurement, subsidy burden, increasing ACS-ARR gap (the gap between average cost of supply and average revenue raised) because of stagnant tariffs, regulatory assets, increasing debt and high cost of finance; and iii. social and political issues such as electricity theft and political interference, especially populist schemes which discourage efficiency and increase the debt burden of distribution companies.

Experts also argue that public-ownership is responsible for the state of the distribution sector and advocate for privatisation as an instrument for addressing its challenges. However, this paper avoids this debate and assumes that while shifting ownership from public to private may posit some benefits, it does not address some of the fundamental challenges of the distribution sector, and it may introduce new risks that are detrimental to the sector's health in the long term.

Various legislative, policy, fiscal and technical interventions have attempted to reform the power sector in the post-liberalisation era, beginning with the Electricity Laws (Amendment) Act 1991, to allow the private sector in electricity generation and allowing 100 per cent ownership by foreign investors in the sector (Verma et al., 2020). The next major milestone was the Electricity Act (2003) which unbundled generation, transmission and distribution in separate corporations. Thereafter, various schemes were supported by the government of India such as accelerated power development and reforms programme (APDRP) (2003), restructured accelerated power development and reforms programme (R-APDRP) (2008), integrated power development scheme (IPDS) (2014), UDAY (2015), Saubhagya (2017) and revamped distribution sector scheme (RDSS) (2021) to address aggregate technical and commercial (AT&C) losses and infrastructure constraints. Evidently, the various schemes have largely failed to achieve their mandate as the accumulated losses of the distribution sector are estimated to be over ₹3 lakh crore between 2017–18 and 2022–23 (PRS Legislative Research, *n.d.*).

RISK LANDSCAPE OF THE DISTRIBUTION SECTOR

While it is often argued that federal politics, poor execution of schemes and inefficient public sector governance are responsible for the present state of the distribution sector, analysing its risk profile may offer critical insights on interventions needed to reform it. We shall focus on particular risks that disproportionately burden this sector in comparison to the transmission and generation sectors.

DEMAND RISK

Power procurement accounts for roughly 70 per cent of the costs incurred by distribution companies. Poor planning, cost overruns and inefficiencies of the coal sector are among the factors that increase procurement costs for distribution companies (Josey et al., 2024). More importantly, it is the distribution company that bears the long-term demand risk. As sectoral planning and infrastructure development, particularly generation and transmission assets, has a horizon of over 10 years, the

distribution companies carry the risk of future demand. Weak demand compared to projections imply low utilisation of generation and transmission capacity, and a higher cost of power procurement. The generation and transmission utilities do not carry this risk as they typically invest only when off-take is secured. On the other hand, once a long-term power purchase agreement is secured, return on equity is assured for a generation or transmission asset irrespective of utilisation because of demand realisation.

Technically, a distribution utility is required to undertake long-term demand studies and take prudent decisions to expand its procurement portfolio. However, assured returns for generation and transmission investment along with political interference in decision-making imply that such prudence is rarely practised.

Theoretically, inefficiencies in planning should result in political accountability as increased tariffs would hurt consumers across industrial, domestic and agricultural categories. However, such accountability is suppressed through subsidies, building regulatory assets and booking losses on the books of public sector utilities, especially distribution companies. In essence, the long-term demand risk is largely concentrated in the distribution sector and the agency of the distribution utilities to navigate this risk is largely suppressed because of the sector's political economy.

SOCIAL AND POLITICAL RISK

Distribution utilities, unlike transmission and generation utilities, directly serve retail electricity consumers. This directly exposes them to social and political risks which doesn't threaten upstream utilities. Distribution companies have to navigate local power structures and disruptive behavioural issues of individual consumers, both being detrimental to their operational efficiency and revenue recovery (Balani et al., 2022). It doesn't help when distribution companies are perennially starved of resources, and they have to deal with disgruntled consumers affected by poor quality of services.

As it directly impacts consumers, an increase in electricity tariffs is a vigorously contested agenda on regulatory

platforms. Despite regulatory processes in place, state-owned distribution companies often end up subduing their annual revenue requirements by over-projecting their efficiency gains, understating their power procurement and other such manipulations. Such practices are evident in the significant difference in costs incurred by distribution companies in their annual truing-up³ petitions. It may be deduced that by virtue of being consumer-facing agencies, distribution companies are exposed to risks because of explicit and implicit political interventions.

TRANSITION RISK

The pathways to clean energy transition present many new challenges for distribution companies. The primary challenge is to integrate renewable energy resources, along with building enough flexibility in the electricity grids to manage in-firm generation and increasingly complex consumption patterns. The latter is being defined by deep electrification across sectors including transport and mobility, along with behind the metered renewable energy and energy storage systems. Energy transition planning is essentially an optimisation problem with a high degree of uncertainty, the cost of which is being borne by distribution companies. The degree to which such costs can be passed on to the consumers will be dictated by the policy and the political-economy landscape.

Another risk to the future revenues of DISCOMs is posed by large consumers shifting to cheaper and greener options through open access. While such consumers can move to open access power procurement, DISCOMs are unable to exit their long-term contracts, increasing their power procurement costs. Often DISCOMs are unable to recover prudent costs for network utilisation, balancing services and energy banking because of regulatory inefficiencies and disinterest of DISCOMs in advocating for their own interest.

STUCK IN A VICIOUS CYCLE

After the unbundling of the power sector, most state-owned generation and transmission companies have been able to build healthy balance sheets, with the exceptions of cases where poor

investment decisions, denial of return on equity under Section 62 of the Electricity Act 2003, or delay in payment by DISCOMs have harmed their fiscal health. However, distribution companies have experienced a systemic drain of resources that have depleted their human resource capabilities and quality of infrastructure. This has further hampered their operational efficiency and revenue recovery, pushing them into a vicious cycle of increasing losses and debt.

ENERGY TRANSITION AND ELECTRICITY DISTRIBUTION

Distribution companies play a vital role that shapes the evolution of the sector itself. Fostering a sustainable and resilient distribution sector is critical to safeguard upstream investments in generation and transmission. Lately, there has been an increased focus on distribution companies and their discipline in determining cost-reflective tariffs. It reflects the increasing realisation that the poor fiscal health of DISCOMs threatens the sustainability of the sector.

The discourse on clean energy transition often centres around addition of renewable energy, treatment of legacy fossil fuel assets and building grid flexibility. It is often ignored that these decisions need to align with the transition trajectories of distribution companies. Whether it is procurement of renewable energy and ancillary (flexibility) services or reduced dependence on fossil fuels, it is the distribution companies who take these decisions to meet their electricity supply obligations. Moreover, being a consumer-facing entity, DISCOMs are well-positioned to understand and influence consumer behaviour to increase demand side flexibility.

Some of the arenas where the role of distribution companies is paramount are:

1. Distribution Efficiency

India's AT&C losses stand at 17.6 per cent⁴. and its electricity grid is estimated to have an emission factor of 0.703 Kg CO₂/kWh (Central Electricity Authority, 2022). If the country is to meet the global distribution loss average of 8 per cent (Statista, *n.d.*), India can avoid emitting 117 million tons of CO₂ annually. This is equivalent to 116 GW of solar photovoltaic capacity (see Annexure 1).

Despite India making significant progress in reducing distribution losses, the real numbers may be far from what is reported (CAG, 2024a; 2024b). Plugging inefficiencies and pilferage in the distribution ecosystem is perhaps the most challenging task, but nonetheless, it is a critical one to ensure that sustainable energy pathways deliver affordable energy access for all.

2. Decentralisation

For various reasons, thus far, renewable energy development has been mostly limited to large generation assets. Utility-scale projects, even though they offer economies of scale, require massive investments in transmission infrastructure. If transmission costs are accounted for, along with transmission and distribution losses, tail-end or distributed renewable energy generation can easily compete with prices for utility-scale projects (Grover and Kulkarni, 2024).

Development of renewable energy and flexibility resources such as energy storage systems coupled with a distribution network can aid in avoiding transmission costs and reducing the cost of energy transition (Walton, 2018). The potential of distributed renewable energy is evident from plans of DISCOMs in Rajasthan to build micro solar plants at 2,334 sub-stations (Vaishnav, 2024). While integration of renewable energy with the distribution network can reduce power procurement costs for DISCOMS and partially defer upstream infrastructure augmentation requirements, it will require comprehensive planning and addressing local technical issues to assure a stable electricity grid that supports evacuation of power from sub-station integration of renewable energy assets.

3. Consumer Participation

Distribution companies directly interface with consumers in more ways than one. An army of linesmen and meter readers interact with them on a regular basis. As last mile suppliers of electricity, DISCOMs have direct insights into consumer behaviours, electricity consumption patterns and emerging trends for energy consumption. This places them in a unique position that allows them to influence consumer behaviour. For instance, DISCOMs in Gujarat and Maharashtra have played a pivotal role in implementing power factor correction and other demand-side management initiatives (Chunekar et al., 2014).

Recently the government of India notified distribution companies as the implementation agency for 'PM Surya Ghar – Muft Bijli Yojana' a central government scheme for promotion of small solar rooftop systems (India.gov.in, *n.d.*).

Distribution companies have the potential to act as an organic conduit for consumer awareness through their frontline workers and mechanisms such as electricity bills. They are also well positioned to undertake small scale-pilots to inform regulatory frameworks and appropriate policies, and for demand aggregation for commercially viable technologies. For instance, Green Mountain Power (GMP) played a significant role in popularising behind-the-meter energy storage systems in Vermont (US) facilitating significant savings for consumers while reducing its power demand requirements, especially during peak consumption times (Mingle, 2019).

4. Power Infrastructure Optimisation

Perhaps the most vital role that distribution utilities can play in shaping sustainable energy pathways is optimisation of investments in the power sector and minimising system-level costs. Achieving distribution loss reduction on par with global standards, promoting decentralisation and consumer participation will play vital roles in achieving the same. Beyond building institutional capabilities to achieve goals in each domain, distribution companies will be required to strengthen their digital infrastructure, data integrity and knowledge capital to leverage the data. While SCADA (supervisory control and data acquisition) systems, smart meters and smart grids can serve to strengthen DISCOMs' abilities to capture high resolution data across the network, a more fundamental requirement is to assure that various sensors and meters deployed to capture critical data are functional and calibrated periodically as per standards. These fundamental issues have been highlighted by third-party auditors in their audit reports of distribution companies. Without assurance of integrity and authenticity of data, planning and modelling for sustainable energy pathways will be completely purposeless.

It may be evident that realising sustainable energy pathways without transforming the distribution sector is nigh impossible. The next section discusses the contours of transformative change for distribution companies, largely focussing on external factors.

TRANSFORMING THE DISTRIBUTION SECTOR

Thus far, efforts at transforming the distribution sector have largely focussed on technology or infrastructure solutions and financial interventions (including bail outs) to ease debt burdens. Over two decades of experience and many national and sub-national interventions indicate the need to rethink strategies and priorities. As discussed earlier, many external factors predispose the distribution sector to challenging risks without the resources and autonomy to mitigate or manage them. This section discusses the plausible macro strategies that may be more effective in rescuing the sector from a vicious cycle of resource starvation, increasing losses and mounting debts.

Some experts may argue that privatisation provides the assurance of improvement in performance of distribution utilities, but it should be evident that even private utilities may not be adept at managing risks as discussed earlier under the subhead ‘What Plagues the Distribution Sector?’. Nonetheless, a critical analysis of privatisation is not considered in the scope of this chapter and we shall presume that long-term sustainability of private utilities also demands addressing some of the fundamental and structural issues discussed. Consequently, the strategies and mechanisms to address the same are discussed below.

1. Managing Long-term Demand Risk

The uncertainty of long-term demand risk is inherent to this sector despite increasing digitalisation across power networks and advancements in forecasting methods. These are attributed to the uncertainty of population changes, economic growth, sectoral shifts, technology advancements, policy changes, climate change and a myriad other factors. Given the long-term horizon for building power infrastructure, investments in the sector are driven by planning and distribution utility-led procurement. While various market mechanisms such as capacity markets and flexibility (or ancillary services) markets are designed to mitigate this risk, they are also shaped by long-term planning.

The risk of deviation of electricity demand with respect to long-term plans can be reduced by ensuring better data for forecasting, advancing forecasting methods and undertaking such exercises periodically. But this risk can't be completely eliminated. Since the burden of this risk falls upon the distribution sector,

and the cost of it can be under-reported to prevent any political consequences, inefficiencies in long-term planning are likely to be prevalent because of the sector's political economy. Such practices may be discouraged by developing mechanisms that fairly distribute asset utilisation risks amongst generation and transmission companies, wherein private players may regulate investments since they are unlikely to invest based on government diktats. However, such mechanisms may discourage investments in upstream sectors.

Given the political economy of the sector, transparency, wider participation and accountability may serve as a pragmatic strategy for ensuring prudence in long-term planning (Lyrio et al., 2018). Improving institutional transparency and accountability is extremely challenging because of vested interests, entrenched practices and the poor state of civic consciousness. However, it may be the only solution for improving the governance of a high-stakes sector with an extremely complex political economy.

2. Fiscal Adequacy

DISCOMs navigate, with varying degrees of success, extremely challenging technical, social and political risks. It is a double whammy for them when they have to perform without adequate human and fiscal resources. For them to do justice to their critical role requires substantial human and fiscal resources.

While advocacy for transition finance has taken centre stage in the recent years, distribution companies will likely struggle to prudently deploy large sums of capital or generate sufficient revenue to sustain such debts unless their fundamental revenue streams are secured. This will imply periodic revision of electricity tariffs without suppression of costs or over-statement of efficiency gains in the succeeding financial years for which tariff petitions are filed by distribution utilities. The timely release of subsidies by respective state governments (Sidhartha and Dutta, 2022) and payment of dues by various government departments (Jahnavi, 2024) also needs to be assured.

The government of India has taken note of these issues and issued the Electricity (Amendment) Rules 2024 that mandate cost reflective tariffs and define that regulatory assets may be created only under extreme circumstance of a natural calamity.

Such executive interventions highlight the urgent need to create discipline in tariff determination and securing healthy cash flows for DISCOMs.

3. Building Institutional Capabilities

Distribution utilities in India have undergone implicit privatisation wherein core functions of the utilities are either executed by contractors or consultants. For instance, key operational functions such as feeder management, fault rectification, billing and metering and grid sub-station management are increasingly managed by contractors. This is apart from major functions in the domain of construction and commissioning of lines, transformers and sub-stations. Further, even core business functions such as energy forecasting, capacity expansion planning and filing tariff petitions are outsourced to consultants.

The practice of outsourcing core business functions to contractors and consultants, including in areas of niche expertise, is contributing to a systemic decline in the capacity of public sector DISCOMs. Novruzov (2024), based on comprehensive literature analysis and specific public sector case studies, argues that over-dependency on external advice can lead to degradation of internal institutional capabilities. Hayes et al. (2022) raise concerns about outsourcing of technical expertise to consultants who may prioritise cost reduction over safety and compromise regulatory outcomes. Experiences from Zambia (Wamunyima et al., 2024) and the National Health Service, UK (Kirkpatrick et al., 2019) show that consulting expenditure is associated with increased inefficiency in public sector organisations.

While outsourcing may have definitive advantages in certain cases and should be considered where business prudence allows for the same, it needs to be carefully thought through in cases where building long-term knowledge capital and capabilities within the institutions is more critical. For instance, this is true for building necessary expertise in long-term planning or managing different generations of metering infrastructure. Further, outsourcing core-business functions to consultants also diminishes accountability since incentives of the consultants are not aligned with the long-term performance of the distribution utilities.

THE WAY FORWARD

DISCOMs can play an authoritative role in defining India's sustainable energy pathway, and plausibly make it financially and politically achievable. This will require substantial financial resources at appropriate costs. However, transition finance shouldn't be just about providing more money, but creating instruments that ensure more money is available for prudent investments. This will require addressing the structural challenges and risks discussed in this article. Otherwise an increased quantum of finance is likely to create more debt burn rather than any returns, efficiency gains or emission reduction.

Structural reforms are likely to face significant resistance from entrenched interests and legacy practices. Standardised approaches may also not work as the cultural and historical context of institutions along with their broader political economy dynamics may differ significantly. Hence, India needs to undertake a comprehensive and participative consensus building initiative like it did to realise sector reforms coded in the Electricity Act 2003.⁵

Consensus building and realisation of structural reforms is likely to be a long-drawn-out process, while the need for distribution companies to plan and invest in sustainable energy pathways is urgent. A short-term or interim solution may be to foster an empowered cadre of people for transition planning and risk management and create an appropriate 'transition fund' to make critical and high priority investments.



Annexure 1: Estimation Equivalent Emission Reduction and Solar PV Capacity to Distribution Efficiency Gains as per the Global Average of 8 Per Cent (2014)

India's AT&C loss, FY 2024	17.60%
India's electricity generation	1,734 TWh
(in Million units)	17,34,000 MUs
Generation avoided at 8% AT&C loss	1,66,464 MUs
India's emission factor (FY 2021)	0.703 Kg CO ₂ / unit
Avoided emissions because of AT&C loss reduction	117 MT CO ₂
Annual electricity generation of 1 MW solar plant	1.44 Mus
Solar capacity equivalent of avoided AT&C losses	116 GW

NOTES

1. *Power Line*. 2024. 'Tackling Losses: Efforts to Revitalise the Power Sector', <https://powerline.net.in/2024/12/05/tackling-losses-efforts-to-revitalise-the-power-sector/> (accessed 14 February 2025).
2. Ratio of high-tension lines to low tension lines.
3. Reconciling actual energy usage with estimated usage.
4. *Hindu Businessline*. 2024. 'AT&C Loss Widens', 12 November, <https://www.thehindubusinessline.com/economy/atc-loss-widens-centre-suggests-states-to-calculate-technical-commercial-losses-separately/article68860459.ece> (accessed 14 February 2025).
5. The Electricity Act 2003 was preceded by exhaustive consultations with state governments facilitated by the Standing Committee on Energy chaired by Santosh Mohan Dev over two years. Various other stakeholders, including industry associations were also included in the process. The final bill put before parliament was the result of negotiations amongst various stakeholders, especially the state governments. (Personal communication with Mr. V. P. Raja, Former Chairman Maharashtra Electricity Regulatory Commission, 2020; Lok Sabha Secretariat, 2002).

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