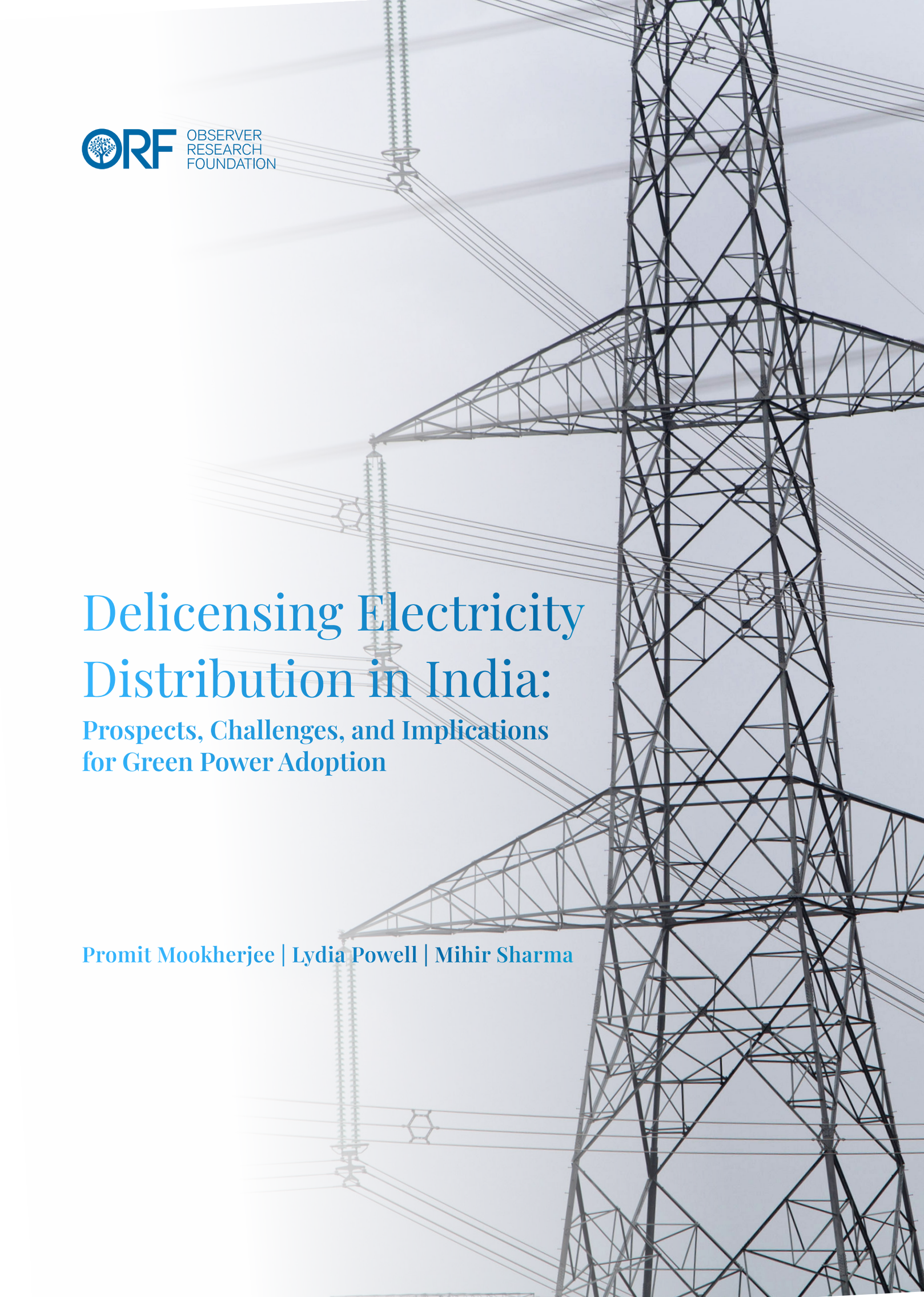


OBSERVER RESEARCH FOUNDATION

Delicensing Electricity Distribution in India:

Prospects, Challenges, and Implications for Green Power Adoption

Promit Mookherjee | Lydia Powell | Mihir Sharma

Delicensing Electricity Distribution in India:

Prospects, Challenges, and Implications for Green Power Adoption

Attribution: Promit Mookherjee, Lydia Powell, and Mihir Sharma, *Delicensing Electricity Distribution in India: Prospects, Challenges, and Implications for Green Power Adoption,* May 2024, Observer Research Foundation.

Observer Research Foundation
20 Rouse Avenue, Institutional Area
New Delhi 110002
India
contactus@orfonline.org
www.orfonline.org

Design and layout: Simijaison Designs

ISBN: 978-81-19656-29-5
ISBN Digital: 978-81-19656-27-1

Cover image: Getty Images/Bloomberg Creative

Contents

Executive Summary

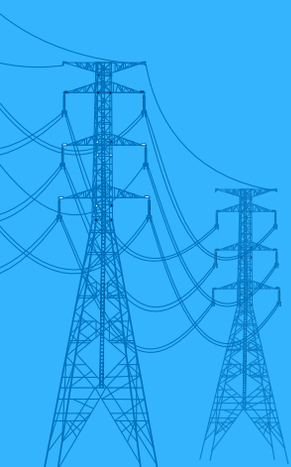
Context

India's development strategy hinges on creating adequate generation capacity and ensuring affordable, reliable power for its growing population. India presently boasts an installed electricity capacity of approximately 425 GW and has made significant strides in extending electricity access to nearly all its populace.

This growth has been driven by substantial reforms to its electricity sector. The Electricity Act (EA) 2003 was instrumental in unbundling the generation, transmission, and distribution segments and laid the groundwork for improving the efficiency of the sector, particularly through greater private-sector participation.

However, given that the electricity sector is part of the concurrent list, the enactment of reforms proposed by the Electricity Act has seen varied levels of adoption across different states. In particular, the distribution sector remains a significant bottleneck. Despite the Central Government's efforts over the past 30 years through the introduction of various initiatives, including performance-based incentive programs and bailout packages, the financial health of this sector remains precarious. In 2022, distribution companies reported substantial financial deficits amounting to INR 78,000 crore. This critical financial condition not only hinders the sector's prospective development but also poses a barrier to India's aspirations for renewable energy advancement.

In an attempt to improve the performance of the distribution segment, the Central Government introduced the Electricity (Amendment) Bill in 2022. This proposed legislation seeks to



delicense the distribution segment. It proposes a radical shift allowing multiple DISCOMs to operate within the same area using a shared network, thereby separating content and carriage and allowing for competition in the retail segment. While the Bill is currently under parliamentary review, its potential impact on the distribution sector's efficiency necessitates careful examination, considering mixed global experiences with similar reforms.

In this context, this study aims to assess the ramifications of this transformative change. The objective is to determine whether this shift can effectively address longstanding issues that have hindered DISCOM operations, leveraging insights from international experiences and past Indian reform endeavours.

India's Electricity Sector Reform Trajectory

The Electricity Act (EA) 2003 altered India's power sector by introducing a governance structure aimed at improving technical performance and fostering competition. It unbundled the electricity sector, with most states transitioning from a vertically integrated framework to a segmented structure managed by distinct entities and supervised by State Electricity Regulatory Commissions, enhancing nationwide electricity generation and delivery.

In terms of private sector participation, while the generation segment has seen notable success, the distribution segment's privatisation efforts have yielded mixed outcomes. Only nine states have some sort of private sector participation in distribution, with widely varying experiences. In some cases, such as Odisha, the implementation of a distribution licensee model has actually led to the worsening financial position of DISCOMs, leading to the eventual cancellation of the contract and various litigations. In other cases, such as Nagpur and Aurangabad, the franchisee contracts had to be cancelled due to issues with payments.

Encouragingly, substantial gains have been visible when private sector participation has been implemented successfully. Private distribution companies have reduced their average AT&C losses to below 10 percent, which is much lower than their public counterparts. Since the implementation of the EA, 2003, AT&C losses across the country have declined, reducing from 38 percent to 16 percent in 2023. Although the

private sector has played a role, the primary reason for this reduction is the improved performance of the public sector, which still manages the majority of India's distribution system. These improvements driven by the Electricity Act of 2003, were enhanced by various government schemes incentivising DISCOMs to boost their technical efficiency.

However, the distribution sector's transformation is being stymied by persistent challenges. These include the lack of cost-reflective tariffs, which prevents DISCOMs from setting prices that accurately reflect supply costs, leading to financial strain. Additionally, the practice of cross-subsidisation, where higher tariffs on commercial and industrial consumers subsidise lower rates for agricultural and household users, further complicates DISCOMs' financial sustainability. Lastly, irregular tariff revisions due to political sensitivities and the regulatory commissions' reluctance to adjust prices in a timely manner exacerbate the financial woes of the distribution segment.

Despite the EA's intentions and some successes, operational and financial performances of DISCOMs in India lag behind developed economies, with key reforms still needed to address the deep-rooted challenges within the sector.

The Electricity (Amendment) Bill, 2022

The key amendment in the Bill concerns allowing multiple DISCOMs in one area. The EA of 2003 permits State Electricity Regulatory Commissions (SERC) to license multiple entities for electricity distribution if each has its own network. The Electricity (Amendment) Bill of 2022 proposes the removal of the licensing requirement, enabling multiple DISCOMs in a single area. The Bill will additionally facilitate the sharing of distribution networks between companies, with the network owner required to grant non-discriminatory access to all competitors in the same area upon payment of wheeling charges. Thus, while the new Bill will not legally separate content and carriage like in other countries such as the UK, it will allow for greater competition at the retail or content stage of the distribution system.

Globally, the primary motivation for delicensing has been to dismantle monopolies, enhance competition, and enable market-driven pricing to reduce costs and improve social welfare. In India, the anticipated reform

aims to increase private sector involvement to mitigate inefficiencies in state-run DISCOMs to improve service quality, innovation, and financial outcomes, alongside fostering green power adoption.

Implementation Challenges

The core principle guiding the governance of India's electricity sector centres on safeguarding low-income consumers from sudden price increases, coupled with a political drive to broaden electricity access. Over time, the strategies developed to uphold these goals, from cross-subsidisation to postponing tariff updates, have inadvertently led to the very issue that the amendments to the Electricity Act aim to address. These measures have resulted in heavily indebted DISCOMs that are struggling to fund the transition to green energy shifting towards more profitable power purchase agreements (PPAs) or delivering satisfactory services to consumers with higher expectations.

From the Union Government's perspective, the objectives of power sector reform are therefore manifold. These include ending the cycle of periodic financial rescues, thus diminishing the need for direct bailouts from the federal treasury. Additionally, the reforms aim to reduce the obscured risk and potential liabilities shouldered by state governments. By enhancing the purchasing power of DISCOMs, the reforms strive to secure investments in the energy transition and ensure a reliable electricity supply. Ultimately, these efforts seek to eliminate a significant macro-prudential risk with the potential to destabilise India's entire financial system.

However, whether the current amendment, aimed at improving retail competition, can resolve any of these issues is still up for debate, particularly because, as highlighted earlier, they have their genesis in regulations and practices beyond the distribution sector. Thus, a critical analysis of the potential challenges and opportunities arising from this new legislation is imperative. Some of the specific challenges that may arise if this legislation is implemented follow:

- **Cherry-picking of customers:** In India, electricity consumers are categorised into subsidised, who pay lower tariffs, and higher-paying consumers, who subsidise the former group. Deregulation could lead to new private companies targeting profitable, higher-paying consumers,

potentially placing a financial strain on state-run DISCOMs by leaving them with subsidised, lower-paying consumers. This scenario raises further concerns for the Union Government, such as the slower expansion of energy access and windfall gains for private entities who are not reinvested in access expansion.

- **Limited benefits for small consumers:** Global experience indicates that increased competition does not necessarily result in lower tariffs for small consumers. With greater involvement of the private sector, there is a tendency towards more innovative tariff models, such as dynamic pricing. Observations from more developed European countries reveal that small residential consumers gain only marginal benefits from these improved options, primarily due to better access to information and lower transaction costs among larger consumers. This disparity is expected to be more pronounced in India, where the information gap between larger and smaller consumers is even wider.

- **Sharing of legacy PPAs:** Allowing new entrants to use existing the distribution network of incumbent DISCOMs raises complex issues regarding the allocation of existing PPAs. Given that most DISCOMs are bound by long-term contracts, accounting for about 90 percent of power procurement in India, devising an equitable method for PPA distribution presents a major challenge. This complexity is amplified by the dynamic and varied nature of consumer demand. Simplistic allocation based on consumer load could prevent DISCOMs from optimising power procurement. Moreover, incorporating existing PPA conditions into new entrants' operations could limit tariff-setting innovation and deter private sector participation due to reduced flexibility and increased entry barriers. Additionally, the necessity for ongoing PPA adjustments with each new entrant complicates regulatory oversight and increases financial risks for generators.

- **Impact on overall appetite of private sector:** The proposed amendments should be viewed alongside existing measures for private sector involvement in electricity distribution. The distribution licensee model has already enhanced efficiency, reduced transmission losses, and improved billing processes. However, the amendments might not significantly boost private sector interest in distribution due to increased risks, including heightened competition and earlier mentioned complications.

- **Entry barriers for new entrants:** For new entrants in the distribution segment, determining entry costs, establishing a customer base, and addressing potential unfair competition with state-run entities are pivotal considerations. To minimise initial entry expenses, the issue of Power Purchase Agreement (PPA) allocation must be addressed. It will also be crucial to distinguish between the costs for private sector participants who develop new infrastructure, such as in rural areas, and those utilising existing networks, due to the stark differences in entry costs. Additionally, the strategy for expanding networks hinges on maintaining low consumer-switching costs, where misaligned incentives present challenges. In various jurisdictions, a significant hurdle is the policy on new connections for consumers with outstanding dues to previous suppliers. The swift resolution of this dilemma is imperative to prevent previous suppliers from unfairly blocking switches due to unpaid bills, which would unfairly disadvantage new market entrants. Simultaneously, measures must ensure that consumers do not exploit the ability to switch providers frequently without settling outstanding dues, maintaining a balanced and fair marketplace.

Impact on Green Power Adoption

Improving the performance of the distribution sector and the successful deployment of renewables are closely linked. The instabilities in the electricity distribution sector severely impede the execution of necessary structural reforms for integrating renewable energy into the grid. Additionally, the precarious financial condition of DISCOMs undermines their capacity to promptly compensate renewable energy generators, thereby obstructing long-term investments in these technologies.

With the delicensing of distribution, there is an expectation that innovative green pricing models deployed by new private sector entrants could act as a means for the greater adoption of renewable energy by consumers. This program may be initiated by new entrants to differentiate their service offering for a commodity such as electricity. Green tariff is expected to remain the most straightforward method for electricity consumers to access renewable energy (RE) power without the need for significant upfront investment in rooftop solar systems, which can be prohibitively expensive, or the complexities of purchasing unbundled RE power through Open Access (OA) provisions, which entail high transaction costs.

However, the deployment of green tariffs may be conditional on the ability of new entrants to source green electricity. For certain private sector entities which have their own generation capabilities, this may be easier since they will be able to purchase electricity for their own facilities. In other cases, the provision of green pricing programs will depend upon the ability to manage green power procurement with long-term PPA commitments. In particular, the creation of real-time wholesale markets will be important for new entrants to be able to manage the demand and supply of green energy in a cost-effective manner.

Even when green pricing programs are implemented, whether consumers will actually be able to adopt these models will depend upon their ability to switch to new entrants offering these services. As mentioned earlier, switching rates among consumers will depend on a number of factors related to the implementation of the delicensing regime. In particular, it is likely that smaller consumers will find it hardest to switch due to high transaction costs and therefore may not be able to benefit from green pricing programs. Moreover, the willingness to pay for green electricity may also be low in India. Studies in other countries have shown that willingness to pay is usually higher for households with higher incomes and education levels, these consumers constitute a small percentage of the total consumer base in India. The experience with green tariffs in the parallel licensing system in Mumbai also suggests that the introduction of green tariffs alone is unlikely to provide a large market for RE.

The EA 2003 established a regulatory framework to support the adoption of RE by mandating state regulatory commissions to set quotas for RE consumption within distribution licence areas. It also facilitated grid connectivity from generation points to consumers and allowed open access for all generators, enhancing competition among retail electricity suppliers. Analysing the factors driving RE adoption among various DISCOMs, both state-owned and private, can provide insights into the impact of competitive retail electricity markets on RE expansion. Although competition may influence these drivers positively or negatively, the absence of a direct comparison (counterfactual) makes it challenging to be conclusive.

- **Resource endowment:** Resource endowment (water, sun, wind) is strongly correlated with RE generation. With the potential introduction of competition in the retail electricity sector, it is anticipated that private

Distribution Licensees (DLs) and Distribution Franchises (DFs) will capitalise on available RE resources within a state to enhance them RE asset base. Nonetheless, the mere presence of these resources does not automatically ensure the generation and consumption of RE-based power. As previously noted, the cost associated with green energy is expected to be higher, and without consumer subsidies (creating demand) combined with set targets and mandates for DLs and DFs (stimulating supply), significant uptake of RE is unlikely to be achieved.

- **Renewable purchase obligations (RPO):** Poor RPO compliance and enforcement remain key challenges for RE adoption by DISCOMs. The introduction of retail competition could possibly lead to improved RPO compliance, particularly by the private DISCOMs. However, the RPO targets need to be flexible to allow DISCOMs to choose RE sources that best suit their own particular load profile in the most cost-effective manner. Furthermore, considering the challenges associated with Renewable Energy Certificates (RECs), which stem from significant market and regulatory uncertainties at both the state and central levels, recent advancements in RE procurement strategies have emerged as effective alternatives. These include competitive bidding processes and innovative market instruments such as the Green Term Ahead Market (GTAM) and the Integrated Day-Ahead Market (GDAM), alongside the use of the Inter-State Transmission System (ISTS) with waived charges. These alternatives are likely to provide more robust options for achieving compliance with Renewable Purchase Obligations (RPO) for private DISCOMs that may enter the retail distribution segment.

- **Payment security:** The establishment of payment security mechanisms for power generators is expected to encourage the production and sale of green power, with private DLs and DFs likely benefiting from more favourable terms due to their efficient financial management compared to state-owned DISCOMs. Foreign investors encounter off-taker risks as a significant barrier to investing in India's RE sector. The government's payment security mechanism aims to mitigate this risk, thereby attracting investment and increasing RE adoption. However, financial sustainability and economic efficiency issues persist among DISCOMs, as evidenced by the poor ratings of Rajasthan and Tamil Nadu's DISCOMs despite being among the top three RE generators. Enhancing payment security mechanisms will be crucial for fostering a

conducive environment for RE generation and adoption, particularly as competition in electricity retail emerges.

- **Resource adequacy planning:** Major challenges of decarbonising the electricity grid include increasing grid flexibility and keeping grids reliable. The introduction of competition in the retail sector is likely to prompt private DISCOMs to invest in advanced technologies and skilled workforce for resource adequacy (RA) planning. This strategic approach will facilitate optimised investment in generation assets and the procurement of power on both long-term and short-term bases. Improved forecasting and planning by DFs and DLs in a deregulated retail market will enable the use of zero marginal cost generating sources, such as solar energy, to minimise costs. This, in turn, is expected to reduce electricity tariffs for consumers, thereby encouraging the adoption of RE.

In 2023, the Ministry of Power (MoP) issued guidelines for RA planning, underscoring the responsibility of DISCOMs, and eventually DLs and DFs, to ensure 24/7 reliable power supply, explicitly stating that load shedding is not an acceptable practice. Looking ahead, there is a need to develop a cost-effective strategy to meet forecasted demand consistently, including a mechanism for resource sharing among states to maximise utilisation. This approach requires a framework centred on reliable grid operations, highlighting the balance between innovation in power distribution and the imperatives of grid reliability and efficiency.

The Way Forward

To address potential challenges from delicensing and retail competition, we outline certain measures to optimise benefits for the distribution segment from the new legislation.

Ensuring pricing flexibility

- Introducing retail competition can incentivise pricing flexibility and encourage new entrants in the distribution segment. However, introducing competition at the retail level when competition is absent in the rest of the value chain may result in sub-optimal outcomes not only in RE adoption but also in economic and technical efficiency.

Considering that, in India, 70-80 percent of the electricity cost paid by consumers is at the generation stage, there is a need to accelerate the reform of wholesale electricity markets and fuel markets to realise the full benefits of retail competition.

- The SERCs will need to be more ambitious in devising price and floors and ceilings. A key criterion in the price-setting formulation should be the consideration of the actual cost of supply. Delicensing provides an opportunity for piloting a new method for calculating the average cost of supply that accounts for the divergence across users in a particular region. There is also scope to implement a graded pricing structure, with different floors and ceilings for consumers with differing power loads. The Central Electricity Regulatory Commission will have to take the lead in devising a new pricing formula which can be piloted in the initial phase of the delicensing exercise.

Preventing cherry-picking and ensuring energy access

- It is essential to establish precise criteria for both deposits to and withdrawals from the Universal Service Obligation (USO) fund. These guidelines must strike a balance between encouraging profitability for new market entrants and minimising the risk of selective consumer targeting. Drawing on the telecommunications sector's approach, one strategy could involve imposing a specific levy on new entrants as a contribution to the USO fund. This will make it easier for new entrants to assess their future profitability while entering a particular area. Nevertheless, the levy's size needs careful calibration to effectively counteract any potential selective targeting of consumers, potentially necessitating variable levies across different areas based on the actual composition of consumers.

- The SERCs will need to set up a system to observe pricing mechanisms being deployed by new private entrants to ensure that discriminatory pricing models are not applied to selective consumers.

Ensuring that benefits reach small consumers

- To protect small consumers from abrupt price increases, targeted subsidies should be offered to those unable to afford higher costs or

unwilling to pay higher prices for better products. Previously, subsidies were distributed through DISCOMs, but there is now a need for direct benefit transfers to ensure that subsidies reach those who need it the most. Furthermore, the advent of unique pricing models by new entrants presents an opportunity to refine the allocation of targeted subsidies. Consumers with a greater willingness to pay for enhanced services can opt for new plans offered by private entities, while subsidies can be more accurately directed towards those in need.

- Once delicensing is implemented and a new company enters a particular area, there is a need for targeted awareness campaigns to inform all consumers of the new entrant. This responsibility can be assigned to local governments through funding support from the centres. There is also a need for a centralised online platform that allows consumers to compare all offerings across different DISCOMs in their area. These awareness programmes should be mandated in the new legislation and carried out periodically to ensure that up-to-date information is available to all consumers.

- SERCs will also need to build capabilities to monitor targeted advertisement from new entrants which are only focused on specific consumer groups. While the legislation currently includes provisions that ensure that new entrants must extend services to all consumers, it must also include specific conditions to prevent the usage of targeted and exclusionary advertisement campaigns.

Creating a level playing field for new entrants

- The state DISCOM cannot both be the unaccountable manager of wires and compete with a private entity that uses those wires. That is a recipe for constant conflict and one that will strongly disincentivise private sector investment. In other jurisdictions, former state distribution companies have been completely converted to managers of the infrastructure. At the very least, separating these roles between two different entities may be required. A precedent for this exists within the public sector in India. The deregulation of aviation in the 1990s proceeded with different state-owned entities (i.e., Indian Airlines and Air India) being responsible for airports and participating in the civil aviation market.

- There needs to be a centrally mandated method for PPA allocation that allows for the creation of a level playing field. If it is left up to the state regulators, there is a perverse incentive for picking methods which will shift a large part of the burden to the new entrant and not the incumbent DISCOM, which is likely to be government owned in most cases.

- An effective contract enforcement mechanism will be essential to ensure that delicensing does not lead to endless litigation that disadvantages new entrants. Currently, disputes between the regulatory authority and private sector players cannot easily be recommended to arbitration, and it is well-known that the normal court system is capable of delaying dispute settlement considerably. Ensuring swifter dispute settlement will be important to keep private sector sentiment positive.

- Based on the experience of other countries, a significant limitation involves the ability of a new provider to furnish a connection to a consumer who maintains an existing account and outstanding payments with the original distributor. Prompt resolution of this matter is critical. On one hand, the incumbent supplier should not possess the unilateral power to block a consumer's switch by citing unpaid dues, as this would create adverse incentives that undermine new market entrants. Conversely, there should be no incentive for consumers to frequently change providers while neglecting their financial obligations. Therefore, accurate meter readings at the time of switching, coupled with an independent assessment regarding the handling of outstanding dues, are imperative.

Enabling green power adoption

- Renewable Purchase Obligation (RPO) targets ought to be technology-neutral, enabling DISCOMs to select renewable energy sources that align optimally with their load profiles. This approach would particularly benefit private DISCOMs, focusing more on cost efficiency and facilitating more strategic planning to enhance RE adoption as a strategy for bolstering their financial performance.

- REC Regulations 2022, which came into effect in December 2022, aimed to restructure the renewable energy certificate mechanism. The new regulations introduced the concept of REC multipliers by

technology, increased the validity of RECs to perpetuity until sold, and, vitally, removed the floor and the ceiling prices for REC trading. The new rules may add to the uncertainty and risk associated with the REC mechanism in terms of technologies and policies at the state and central level.

- The flexibility of Renewable Energy Certificates (RECs) must be enhanced to keep pace with changing market dynamics. In this context, International Renewable Energy Certificates (I-RECs) provide a valuable model. The advantages of I-RECs over traditional RECs include the allowance for bilateral trading of I-RECs and the cross-border flexibility provided to market participants. By enabling international stakeholders to engage in the REC market, India can leverage the benefits of bilateral REC trading, a mechanism that became operational in 2024.

- New RE procurement strategies, such as the Green Term-Ahead Market (GTAM) and the Integrated Day Ahead Market (GDAM), along with the use of the inter-state transmission system (ISTS) that now offers waived charges, are now in competition with RECs for meeting RPO compliance. Should competition within the retail electricity sector be introduced, private DISCOMs in a deregulated market are likely to favour these emerging procurement methods. These alternatives are seen as offering greater transparency and predictability compared to the traditional REC mechanism.

Conclusion

Overall, the impact of retail competition on green power adoption will depend on several factors. In particular, the implementation of broader reform agenda for the distribution sector will substantially impact the ability of delicensing to improve efficiency in the distribution sector and encourage green power adoption. Moreover, studies indicate that, while privatisation, competition, and regulation are beneficial, implementing them all at once may not lead to positive outcomes. Recent empirical research on reform in developing countries has concluded in favour of gradualism, which emphasised the importance of first establishing institutional infrastructures that are conducive to market forces, including setting up competitive industrial structures and appropriate regulatory systems. In the Indian case, primary fuel markets are regulated and wholesale electricity markets are

not dominant. Introducing competition at the retail level when competition is absent in the rest of the value chain may result in sub-optimal outcomes not only in RE adoption but also in economic and technical efficiency. However, if delicensing is to be implemented, there is a need for strong regulatory oversight and support to ensure that implementation leads to actual benefits for both consumers and DISCOMs.

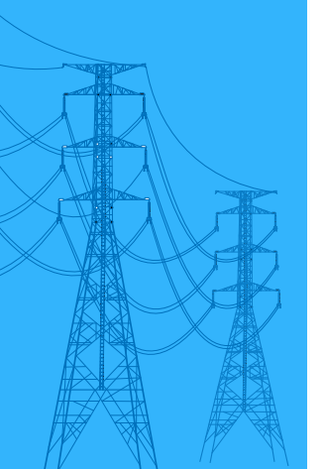
(Certain parts of this report have been previously published in ORF's Energy News Monitor*, Volume XX, Issue 26, February 12, 2024.[1])*

Introduction

Creating adequate generation capacity and providing affordable and reliable power to its ever-growing population are pillars of India's development strategy. India's power production capabilities have increased from a low 1.4 gigawatts (GW) at the time of Independence to 425 GW of installed capacity derived from both fossil fuel and renewable sources.[2]

India's power sector has seen multiple transformations to enable this growth. Historically, the sector was operated under a vertically integrated structure where generation, transmission, and distribution were all controlled by government entities. After the economic reforms in the early 1990s, there was a rapid acceleration in electricity demand, driven by a growing industrial and commercial sector. This necessitated large-scale additions to the electricity generation capabilities, prompting the first attempts at involving the private sector.

The first step was the establishment of an independent regulator for the sector: the Electricity Regulatory Commission. This was aimed at improving the commercial viability of the sector to attract larger private investments, leading to improvements in the quality and quantity of service. The Electricity Regulatory Commissions Act was implemented in 1998,[3] which established the Central Electricity Regulatory Commission (CERC) and enabled states to set up their own State Electricity Regulatory Commissions (SERC). However, the Act only empowered states to set up their electricity commission without mandating them to do so.[4]



The reform of the power sector achieved real momentum with the passing of the Electricity Act, 2003.[5] This Act aimed to consolidate the laws relating to generation, transmission, and distribution with a strong focus on improving competition. The main provisions in the Act include mandating the setting up of SERCs and the unbundling of State Electricity Boards into generation, transmission, and distribution companies. Moreover, the Act had a focus on facilitating open access and enabling captive generation.

Since this Act was incorporated, the generation sector, in particular, has seen increased competition. The generation capacity of the private sector has seen rapid growth. From being completely dependent on the public sector for power generation post-independence, currently, the private sector accounts for 51 percent of power generation, and the rest is distributed evenly between Central and state agencies. This has been a key driver of India becoming a power-surplus country with a total installed capacity that is double that of peak electricity demand.[6]

Transmission remains monopolistic in nature, particularly because of the high initial capital investment as well as other issues related to the right-of-way for establishing the network.

The distribution sector remains largely operated by the public sector despite significant efforts to include the private sector. There are both successful examples of privatisation, such as in Delhi, as well as notable failures, such as in Odisha, which was the first state to attempt privatisation.

Today, the distribution remains the weakest link in the electricity system. In FY 2022, financial losses of distribution companies (DISCOMs) reached INR 78,000 crore.[7] A key part of this has been the high aggregate technical and commercial (AT&C) losses incurred in the process of providing electricity. The argument for privatisation has focused on the need for efficiency gains that could reduce these losses. However, the tariffs remain highly regulated and there are limited opportunities for the private sector to make profits. Moreover, there is also political reluctance to shift to privatisation mainly due to a perception of job losses and a dilution of the welfarist nature of state-owned DISCOMs.

With the reforms initiated in the Electricity Act, 2003 meeting with limited success, the Centre recently put forward the Electricity Amendment Bill

2022 with a specific focus on delicensing the distribution sector to enable greater retail competition. Whereas currently, a DISCOM can supply electricity in a particular area if authorised to do so through a licence, the amendment aims to delicense the sector and allow multiple companies to supply electricity in the same area. There is an expectation that competition between different companies in the same area will improve competition and thereby the overall efficiency of the sector.

This Bill comes at a time when improving the efficiency of the distribution sector and reducing the losses of DISCOMs is imperative for two key reasons:

- Electricity demand in India is expected to grow rapidly in the next few years. Providing affordable and reliable electricity will be a key prong for India to achieve its development goals. Meeting this escalating demand will necessitate substantial investments in the augmentation of generation, transmission, and distribution infrastructure. A pivotal facet of India's strategy involves enhancing the financial stability of DISCOMs to foster increased investments in infrastructure initiatives, particularly in metering and billing systems. Moreover, the poor financial state of DISCOMs also leads to an inability to pay generators on time, hindering the performance of the generation sector and leading to lower investments.

- India's power sector is going through a major transformation due to the need to integrate greater amounts of renewable energy into the grid. This will require greater flexibility from DISCOMs to deal with the variable nature of renewable energy, particularly for integrating greater distributed renewable energy into the grid and matching demand supply. This will also require DISCOMs to identify newer business models that can help accelerate the adoption of renewable energy, particularly through innovative pricing instruments.

In this context, this study aims to take stock of the current progress around reforming the distribution sector. In particular, the report looks at the progress, if any, in the reforms envisaged in the Electricity Act, 2003 and how far they have succeeded in improving competition and increasing the efficiency of the distribution sector. The report then assess the newer provisions proposed in Electricity (Amendment) Bill 2022, including the

theoretical underpinnings for the new amendment. In particular, the study examines how learnings from previous reform efforts can inform the separation of content and carriage. The challenges for implementing the new provisions are discussed, and the potential impacts on different consumer groups are highlighted. Finally, the report explores how the distribution sector reforms might impact the adoption of green energy in India. In each of these sections, this analysis aims to highlight regulatory frameworks and policy interventions which aid in creating a cohesive and effective reform agenda for the sector going forward.

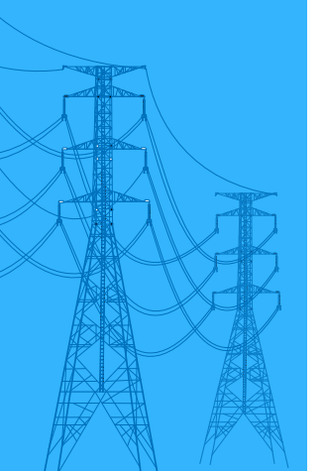
This study draws insights from a comprehensive review of existing literature, encompassing government, academic, and grey literature sources from both India and other countries. The findings are enriched by diverse consultations with stakeholders and experts, shaping the final assessments presented in the subsequent sections.

Trajectory of India's Electricity Sector Reforms

Key Features of the Electricity Act, 2003

The Electricity Act, 2003 (EA, 2003) was the first major attempt to build comprehensive legislation to accelerate the incremental reform attempts made in the prior decade. The Act was first proposed in 2001 and passed in 2003 and after two years of debate in Parliament. The Act put forward various measures to promote competition, improve transparency, improve DISCOM efficiency, improve electricity access, and promote renewable energy.

To encourage competition in the sector, the Act created a new governance structure for the electricity sector. It mandated the creation of SERCs, which had thus far been optional. This was viewed as a key step towards creating a conducive regulatory environment to encourage private sector participation. Regulatory commissions were also empowered to determine the tariffs for the supply of electricity from generating companies with the stated objective of progressively reducing the cross subsidisation of electricity for agricultural and residential consumers by the commercial and industrial segment. The Act also provided a provision for the constitution of an Appellate Tribunal with the power to hear appeals against the CERC/SERC to speed up the redressal process by reducing the delays in obtaining decisions through the High Court. This was seen as an important step for creating an even playing field for the private sector.



There were also specific provisions in the Act for different segments of the electricity sector:

- **Generation:** Regulatory requirements were eased to promote private sector involvement, enabling companies to establish and operate generating plants without the necessity of acquiring a license. Moreover, individual entities were granted the authority to establish captive generation facilities along with dedicated transmission lines. The Act unambiguously clarified open access as the unbiased utilisation of transmission infrastructure by any entity engaged in electricity generation.

- **Transmission:** Transmission companies continued to be licensed through the regulatory commissions and load dispatch continued to be controlled by a government entity. A significant provision for this segment was the mandate to provide open access to transmission lines to distribution licensees and generating companies. This was aimed at increasing the competitive pressures on transmission, eventually improving efficiency and cost reductions.

- **Distribution:** The SERCs were empowered to be the sole agency that could provide licenses to distribution companies and also control the retail tariffs. The Act additionally mandated the gradual implementation of open access in distribution while providing provisions for the imposition of supplementary surcharges, in addition to wheeling charges. These measures were introduced to offset cross-subsidies and uphold the licensee's obligation to supply.

The provisions within the EA, 2003 serve two key objectives. Firstly, they strive to establish an effective regulatory framework and redressal process, fostering an environment conducive to increased private sector engagement in both generation and distribution. Secondly, the Act aims to delineate economic decision-making in the sector from political influence, ensuring a more autonomous and objective decision-making process.

Despite the clear intent and provisions in the EA, 2003, interest from states and progress on improving competition in the distribution sector has been limited.

Odisha was the first state to implement the privatisation model. It implemented its own reform Act in 1995, unbundled its State Electricity Board, and set up its own SERC. In 1999, the state-owned distribution business was divided into four companies, which were then privatised.[8,9] However, implementation proved to be a challenge, and this experience is largely considered a failure. One of the private companies stepped away, while the licences for the other three were revoked by the state regulator. A committee appointed to assess the reform effort of the state pointed out that there were many gaps in the reform process, and even after spending billions of dollars, the benefits were minimal.

The committee found that, in the five years after the reforms were implemented, the financial position of the distribution segment had worsened substantially. Transmission and distribution losses had not reduced to the expected levels, and collection efficiency had deteriorated from 84 percent to 77 percent. This was a clear indication that the primary motive of privatisation—i.e., improving the efficiency of the sector—had not been achieved. Moreover, the loan burden on the GRIDCO (state-owned transmission company) had increased four times in the first five years after the reform. The Committee also highlighted that the Odisha reform package was largely based on guidance from international organisations such as the World Bank and DFID, with fees for foreign consultants to enable this process almost totaling INR 300 crore. Since then, there has been substantial blowback on the reform agenda driven by international organisations. This was one of the major motivating factors for India to create its own reform agenda through the EA, 2003.

Post the Electricity Act, 2003, other regions adopted privatisation efforts to different degrees. Two predominant models of private participation have prevailed in India, both with their own unique experiences.

Distribution Franchisee Model

The distribution franchisee (DF) model allows the state government to bring in the private sector to carry out specific operations within the distribution segment while maintaining overall ownership. It is a form of quasi-privatisation that has the potential to allow the private sector to enter into functions, improving efficiency through better operational and managerial interventions. This holds the promise of reducing losses, particularly

those from low collection and billing efficiency that plague public sector operations. This model also requires lower capital expenditure on the part of the private sector compared to the complete ownership model.[10]

There are two main types of DF models. In the input-based model, franchisees handle operations from power procurement, while in the other model, responsibilities are limited to the final billing and collection stage.

Several states have experimented with different versions of the DF model. Perhaps the most well-documented and successful example is the first DF model, which was implemented in Bhiwandi, where the Maharashtra State Electricity Distribution Company Limited (MSEDCL) entered a DF contract with Torrent Power in January 2007.[11] This was an input-based model where the franchisee bought power from the licensee at a predetermined rate and handled all operations related to distribution. The distribution sector in Bhiwandi showed sustained financial improvement post the reform; in just the first two years, the AT&C losses had come down from 63 percent to 19 percent and franchisee revenue had more than doubled, from INR 160 crore in the first year to 344 crores in the second year.[12] A major part of this improvement was also the result of the improved distribution infrastructure, as Torrent Power had invested around INR 200 crore within the first year.

Post the success of the Bhiwandi model, various other regions have implemented the DF model, with a majority of the states adopting the input-based DF model. However, not all DF models have been as successful as Bhiwandi. Issues such as non-payment of dues have led to the cancellation of DF contracts in multiple regions, including Nagpur and Aurangabad, and multiple states such as Madhya Pradesh, Uttar Pradesh, and Jharkhand. However, most cases of DF contract cancellations have been in the earlier years of implementing these models (roughly pre-2015). The major issue has been the lack of clarity in the policy and legal framework to support the DF model, which has led to various clashes between the franchisee and the licensee.[13] However, over time, both governments and the private sector have been able to work together to establish a more supportive environment for the adoption of the DF model.

Table 1: Types of Distribution Franchisee Models

	Input-Based Distribution Franchisee	Revenue-Based/Collection-Based Franchisee
Responsibilities	Supplying power from the point of input	Improving billing and collection process
Payment	Power is procured at a predetermined rate from the DISCOM, with the surplus obtained after selling to the customer being the profit of the franchisee	Fixed fee
Capex commitments	Investment in transmission infrastructure and billing and collection mechanism	None
Responsibility for power procurement	Franchisee	DISCOM
Objective	Improving the financial performance of the DISCOM and improving billing and collection efficiency	Improving operational efficiency and better customer experience
Examples	Odisha, Bihar, Maharashtra, Uttar Pradesh, Jharkhand, Madhya Pradesh, Rajasthan	Assam, Andhra Pradesh

Source: Authors' own

Distribution Licensee Model

The licensee model involves an actual transfer of ownership from the state-owned DISCOM to a private company. The private party is responsible for all distribution-related functions, including ownership of all assets. The level of privatisation can also be customised, with the state-owned utility

retaining a minority share in the utility and the private company retaining all management control.

The licensee model provides greater potential to fully leverage the efficiencies associated with the private sector since they have greater ownership and control over the whole system. However, it is also more financially demanding, with greater capital investments needed in some cases. Thus, the successful deployment of this model might also necessitate financial support from the state government, particularly in the initial stages, where the past inefficiencies of the system can impact financial returns.

While the first attempts at privatisation in Odisha are an example of the failure of the licensee model, more recent efforts in Delhi, Surat, Ahmedabad, and Kolkata have shown positive signs. In Delhi, the Delhi Vidyut Board was unbundled in 2001 and separated into a generation company (GENCO), a transmission company (TRANSCO), and three DISCOMs.[14] The majority stakes in the DISCOMs were handed over to private companies through a competitive bidding process. This move was prompted by the rapidly increasing losses of the state DISCOM, which had more than doubled from INR 524 crore in 1994 to INR 1,186 crore in 2000-01.

TATA Power secured a majority share of 51 percent in the northern region, while Bombay Suburban Electricity Supply (BSES) obtained distribution rights in South, Southwest, Central, and East Delhi. Since then, the financial performance of the distribution segment has improved substantially. In the first five years, AT&C losses were brought down from 54 percent to 38 percent, leading to substantial improvement in the performance of DISCOMs, which went from loss-making entities to making consistent profits since 2007-08. Currently, the AT&C losses in Delhi stand at only around 8 percent. Recent estimates suggest that, in the two decades since the reform, the three DISCOMs had cumulatively saved INR 1.2 lakh crore while also providing more reliable and affordable electricity to the city's population, with the energy deficit in Delhi decreasing from 1.9 percent in 2002-03 to 0.6 percent in 2008-09.[15]

The privatisation of DISCOMs in Delhi was also accompanied by extensive capital expenditure to mitigate losses stemming from electricity theft and technical inefficiencies. Government support was a key part of the

Delhi success story. The companies had baked into their contract several financial incentives which were linked to the achievement of targets related to the reduction of AT&C. Until 2007, DISCOMs were assured 16 percent of revenues on their assets, along with 50 percent of any additional revenue resulting from enhanced operational performance. Moreover, the past liabilities and losses of Delhi Vidyut Board were not passed on to the newer companies, and a loan of up to INR 3,450 crores was granted to the transmission company in order to avoid tariff shocks as DISCOMs altered their prices as losses reduced. The state government also created a clear plan for transitioning existing employees of DVB to the new DISCOMs, thereby creating greater political and public acceptance of the privatisation efforts.

Outcomes from Existing Reforms

While strong legislation at the national level has set the stage for reform of the power distribution sector, the level of interest and commitment among states in implementing the provisions of the EA, 2003, has been diverse. A study by the World Bank in 2014 found that there was wide divergence in terms of reforms implemented.[16] At that time, most states had completed only half of the envisaged reforms. However, the reforms related to promoting competition were the least implemented, with more than half of the states implementing less than a quarter of the reforms envisaged in the Act.

In terms of mandating the unbundling of the electricity sector, all but seven states have moved away from a completely vertically integrated structure. However, in many cases, the unbundling is limited to technical segregation and not necessarily operational autonomy. The newly created companies are often dependent on their parent companies for human resources, investment decisions, and other efficiency improvements.[17] This leads to a situation where there is substantial dependence between different companies in the chain, which compromises the ability of each entity to function independently. This can lead to further compromises on efficiency and competition. For example, state-owned DISCOMs may choose to purchase electricity from the state-owned generator even when cheaper power is available from other sources.[18]

Table 2: Status of Unbundling of the Electricity Sector, by State

Vertically Integrated: Power Department	Transmission Separation: GEDCO (Generation & Distribution Co)	Unbundled with Single Public Discoms	Unbundled with Multiple Public DISCOMs and/ or Private Licensee/ Franchisee	
Arunachal Pradesh	Himachal Pradesh	Assam*	Andhra Pradesh	Maharashtra*#
Goa	Kerala	Chhattisgarh	Bihar	Odisha*#
Jammu and Kashmir!	Manipur	Jharkhand	Delhi#	Rajasthan*
Mizoram	Punjab	Meghalaya*	Gujarat*#	Uttar Pradesh*#
Nagaland	Tamil Nadu	Uttarakhand	Haryana	West Bengal*#
Puducherry	Tripura*		Karnataka	
Sikkim			Madhya Pradesh*	

Note:

! J&K's GENCO was set up as a private limited company

** indicates presence of private franchisee model*

 # indicates presence of private licensee model

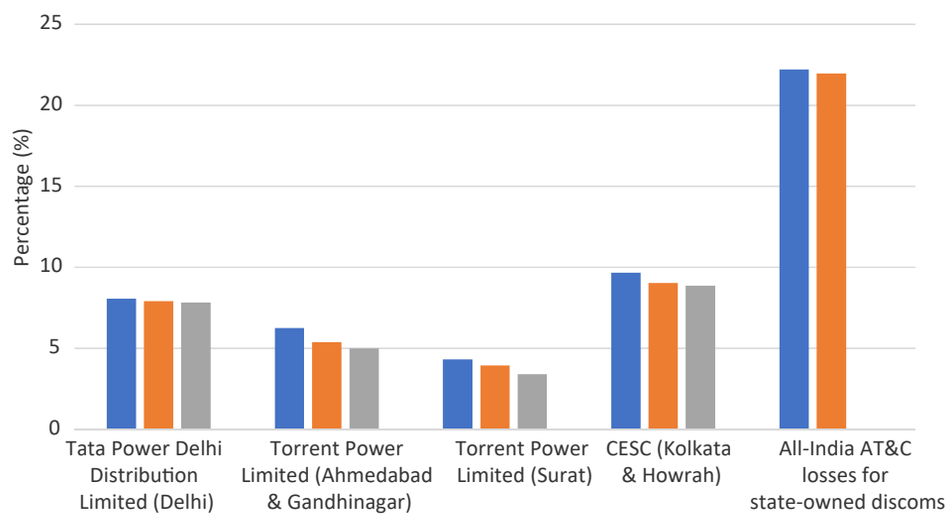
Source: NITI Aayog[19]

Despite the vertical unbundling and implementation of other reforms related to regulatory oversight, regulator independence, and utility corporatisation, participation of the private sector in distribution has been limited. Only nine states have some form of private sector participation in distribution. Certain states stand out as leaders, expanding the privatisation model beyond initial experiments in one region to encompass multiple areas. Maharashtra, Madhya Pradesh, Gujarat, and Odisha stand out as the states that have experimented the most widely with privatisation.

As mentioned earlier, states have had differing levels of success when including the private sector in distribution. However, private DISCOMs

largely perform better than state-owned ones in terms of operating efficiencies and financial health (see Figure 1). The distribution losses in the area of operations of Tata Power in Delhi, Torrent Power in Gujarat, and CESC in West Bengal are lower than 10 percent compared to the all-India average T&C losses of around 16 percent. Torrent Power performs the best in this regard, with distribution losses remaining below 5 percent in all three regions of operations—Ahmedabad, Gandhinagar, and Surat—in FY 2020.

Figure 1: Trends in Distribution Losses for Private DISCOMs vs All-India AT&C Loss Level for State-Owned DISCOMs

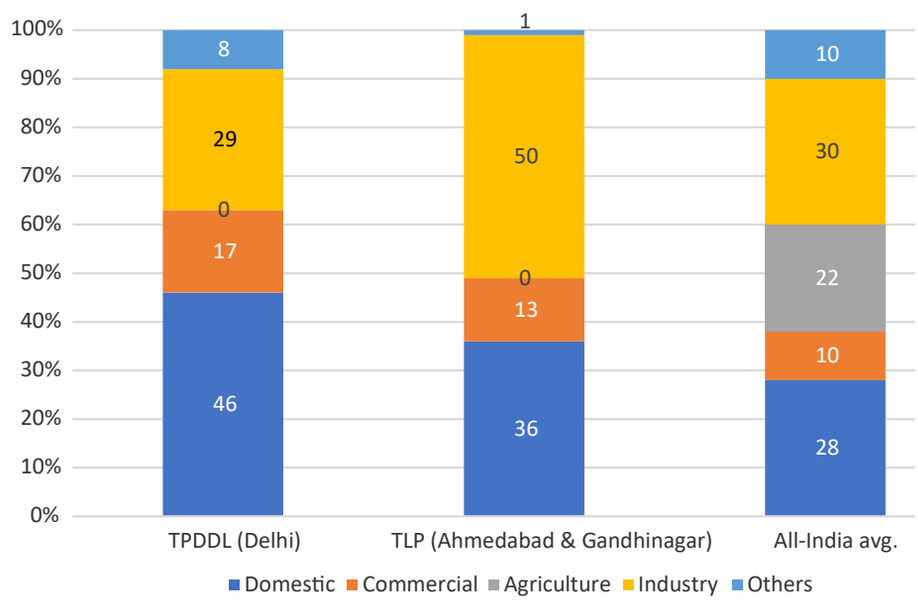


Source: ICRA[20]

However, the area of operation of private DISCOMs does not reflect the overall consumer mix for India. Private DISCOMs have been concentrated in well-developed urban areas, where the consumer mix is largely homogenous and comprises mainly domestic, commercial, and industrial consumers (see Figure 2). Thus, private companies entering the distribution business in these areas have very low exposure to agricultural consumers. As a result, the cross-subsidisation requirement for these DISCOMs is quite low, as is the dependence on government subsidies to balance their books. Moreover, these DISCOMs operate under a cost-plus tariff model, where the tariff is determined keeping in mind the cost of supply and adding a certain profit percentage. As a result, even variations that exist across their customer mix can be passed on to existing consumers in a time-bound manner—something that is harder to implement for state-owned DISCOMs.

However, this does not reflect the overall consumer mix for the country. Thus, the financial success of private DISCOMs cannot be assumed to be applicable throughout the country and must be viewed selectively within the geographical context in which they operate.

Figure 2: Consumer Mix of Selected Private Discoms vs All-India Average



Source: ICRA[21]

Persisting Challenges

The financial position of the distribution sector has, to some extent, seen an improvement due to the successful reduction in AT&C losses, from 38 percent in 2003 to around 16 percent in 2023.[22] While increased competition and private sector participation have been contributing factors, the improved performance of the public sector remains the major reason behind the improved performance. The upgradation of the sub-transmission and distribution network, the improvement in billing and collection, and the installation of smart meters have been some of the key drivers of improved performance. This has been enabled by a variety of schemes in addition to the EA, including the Accelerated Power Development and Reform Programme (APDRP), which was instituted in 2003 and approved as a Central scheme in 2008 as the Restructured Accelerated Power Development & Reforms Programme (R-APDRP). This was implemented as an incentive-based

program, where participating utilities would receive financial assistance from the Centre for demonstrating performance improvements over a certain baseline. This scheme also provided grant funding to strengthen the distribution infrastructure, including strengthening sub-stations, improving transformer centres, feeder separation, load balancing, installation of high voltage distribution systems (11kV), and installation of tamper-proof electronic meters.[23] However, despite some success, the scheme fell short of meeting its target of reducing AT&C losses to 15 percent. Moreover, while the total budgetary allocation of the two schemes was around INR 32,000 crore, only around 33 percent of the amount was actually disbursed to the utilities. The lack of interest from the utilities was due to a dissonance between the Centre and utilities because the targets under the scheme were considered too ambitious and there were delays in payments to the utilities since these were routed through state governments.[24]

More recently, the Ujwal DISCOM Assurance Yojana (UDAY) scheme was launched in 2015 with the aim of continuing past efforts to reduce the liabilities of DISCOMs. Under the UDAY scheme, participating state governments are obligated to take on 75 percent of the debt burden of DISCOMs. The scheme facilitated the takeover of DISCOM debt through the issuance of bonds, utilising a combination of equity, grants, and loans. This was conceived as a strategy to enhance the balance sheets of DISCOMs, consequently bolstering their capacity to secure credit for infrastructure improvement and creating room for expanding their power procurement capabilities. Since its initiation, 27 states have entered into Memoranda of Understanding (MoU) with the Union government, aligning themselves with and participating in this scheme.[25]

In addition to these schemes, the Centre has implemented various financial restructuring schemes to bail out utilities. The initial bailout package, launched in 2002 through a tripartite agreement involving the Reserve Bank of India and the Central and state Governments, featured an interest waiver on 60 percent of delayed payments for participating utilities. The remaining payments were securitised through a 15-year low-interest bond. This incentive was offered to utilities in return for implementing reforms such as establishing SERC, enhancing metering, and improving revenue realisation. A subsequent package was rolled out in 2012. Under this scheme, 50 percent of the short-term liabilities of the utilities were to be taken over by the state government and converted into bonds. The

remaining debt was restructured by banks with a three-year moratorium.[26] The financing mechanism was also set up, whereby the utility could receive grants linked to the AT&C loss reductions. All these benefits could be availed by participating utilities conditional on improvements in operational performance.

In 2020, the Central Government announced a reform-linked liquidity infusion scheme amounting to INR 90,000 crore aimed at settling the overdue payments of DISCOMs.[27] This one-time infusion will be extended to DISCOMs as loans backed by state government guarantees and directed towards public sector generation and transmission companies, independent power producers, and renewable energy producers. The disbursement of these loans will occur in two tranches, contingent upon specific reforms emphasising the digitalisation of payment systems, enhanced metering, and the implementation of comprehensive plans to reduce losses.

However, despite these efforts, the improvements in the overall financial position of the distribution sector have only been incremental. The current level of AT&C losses is still much higher than the global average of around 8 percent and the goal of achieving 15 percent AT&C loss, envisaged in the UDAY scheme, has also not been realised.[28] The overall financial position of DISCOMs has only gotten worse. IN FY22, the accumulated losses on the balance sheet of distribution utilities stood at a staggering INR 5.5 lakh crores, with an outstanding debt of INR 6.17 lakh crores.

Despite a robust reform agenda, the distribution segment faces persistent challenges that impede its transformation. While privatisation and competition present potential solutions, the same underlying issues impeding DISCOMs from reducing losses also pose the most significant obstacle to heightened private sector participation.

- **Lack of cost-reflective tariffs:** The efficiency and profitability of distribution utilities hinge on the ability to charge tariffs that accurately mirror the true cost of supply. In India, tariffs are calculated based on an overall average cost of supply (ACS), which is estimated by calculating the average per-unit cost of electricity when it is equally distributed across every unit of energy supplied by the utility. However, this method fails to accurately capture the varying costs associated with supplying

electricity to different consumer categories—a crucial consideration in India, where these costs exhibit significant disparities.

High-voltage consumers are inherently cheaper to supply power to because they rely less on distribution infrastructure and have better access to instruments on premises that can handle power at high voltage. In the case of lower-voltage consumers, more transformations are required to effectively supply electricity to them, leading to higher costs of supply. Compounding the challenge is the existence of numerous sub-categories within the tariff slab, each with its distinct cost of supply, further obscuring the accurate reflection of these costs. CRISIL's analysis reveals a range of sub-categories, varying from 14 in Delhi to 72 in West Bengal.

- **Cross-subsidisation:** In addition to the lack of cost-reflective tariff, the ability of DISCOMs to generate profits is further hindered by explicit cross-subsidisation, where higher tariffs imposed on C&I consumers subsidise the lower tariffs applied to agricultural and household consumers. Cross-subsidised consumers receive a significant discount in their tariff and do not even pay the distorted ACS. The average billed rate for household and agricultural consumers is only between 34 percent to 84 percent of ACS.[29] To recover these costs, higher tariffs are imposed on C&I consumers. This is in stark contrast to the practices in developed economies, where industrial consumer power costs are deliberately kept low to foster industrialisation and spur economic growth.

  The distortions in the tariff-setting process have resulted in a situation where the overall gap between average revenue realised and the average cost of supply at a national level is still around INR 0.28/ kWH (down from INR 0.47/ kWH in 2015-16).[30] This is one of the main reasons that DISCOMs are unable to create effective business models that ensure profitability. Moreover, uneven growth between different consumer categories has further affected the profitability of DISCOMs. Increased electrification and rise in per-capita income, combined with tepid industrialisation, has resulted in the faster growth of residential and agricultural consumers compared to C&I consumers in the last decade (compound annual growth rate: 7.09 percent vs 5.3 percent) translating into greater losses for DISCOMs.[31] This problem is starker

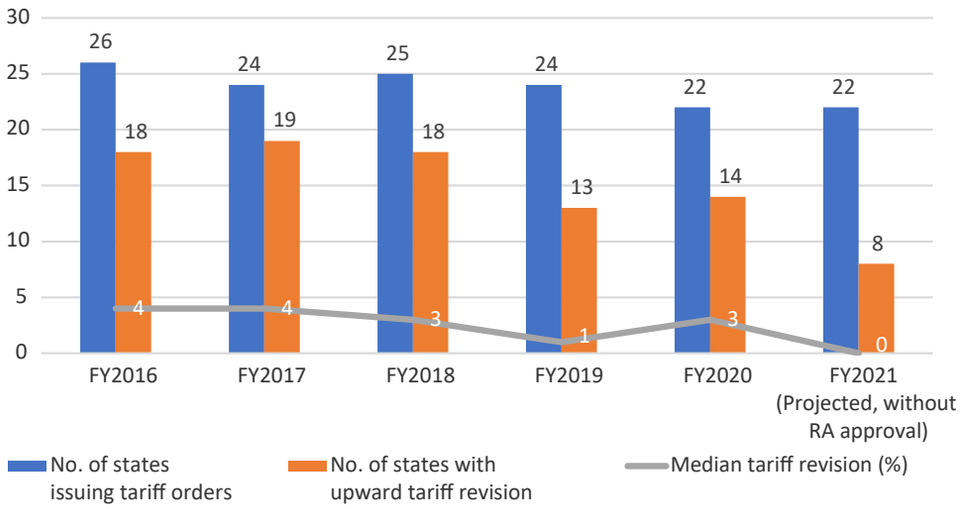
for states, where industrial consumers make up a smaller percentage of the consumer mix. There is a strong correlation between DISCOM losses and the proportion of agricultural and residential consumers in the overall consumer mix in a particular state.

The negative impact of cross-subsidies on the efficiency of the distribution sector has been well recognised. Beginning with the EA, 2003, various legislations and schemes have mandated or encouraged the need for SERCs to reduce cross-subsidies. The National Tariff Policy 2016 has prescribed a phased reduction in the cross-subsidy with the goal that the average revenue realisation (ARR) be within 20 percent below or above the ACS. However, barring a few states such as Gujarat and Bihar, which have rationalised tariffs, the remaining states are far from implementing this change. The main impediment to addressing this issue lies in a deficiency of political will, as elevating tariffs for agricultural and residential consumers, which is consistently unpopular. This scenario exemplifies the ongoing challenge in India of establishing independent regulators capable of making decisions rooted solely in economic principles.

- **Irregular tariff revisions:** In addition to distortions in the tariff-setting process, tariff revisions are also irregular. Tariff increases in India follow a regulatory process where SERCs revise tariffs based on a periodic petition filed by DISCOMs. However, DISCOMs are often reluctant to file petitions for tariff revisions due to political sensitivities around price hikes for electricity. SERCs are endowed with the authority to initiate tariff revisions suo moto under specific conditions but rarely utilise this power.

  As a result, tariff revisions lag behind the increases in the cost of supply. The UDAY scheme proposes that all states engage in quarterly tariff revisions. Nevertheless, as seen in Figure 3, numerous states fail to issue tariff orders even annually, and even when these orders are issued, actual upward tariff revisions do not consistently materialise and median tariff rise also remains low and less than the rise in fuel costs. States where the issuance of tariff orders was most delayed, such as Rajasthan, Tamil Nadu, and Uttar Pradesh, also account for the highest share of the debt taken over by state governments under the UDAY scheme.

Figure 3: Issuance of Tariff Orders, by State



Source: ICRA[32]

To complicate matters further, SERCs also utilise another instrument, called regulatory assets (RA), to delay actual increases in tariffs. RAs are issued by SERCs when they recognise that tariffs fall short of covering the supply costs incurred by DISCOMs. Rather than immediately raising the tariff, SERCs allow DISCOMs to document the revenue-cost gap as a receivable on their balance sheets as RAs. Subsequently, these shortfalls are either amortised or gradually recouped through future tariff adjustments. However, the handling of RAs varies across jurisdictions, often resulting in their prolonged presence on DISCOMs' books since SERCs often do not put forward clear timelines for resolving these RAs.

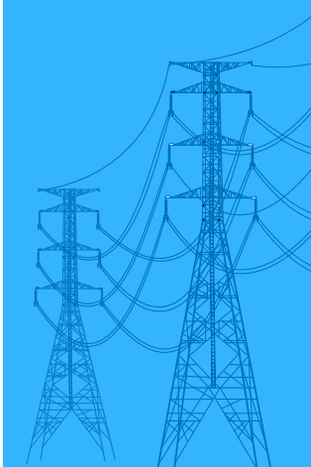
RAs were envisaged as an emergency measure, only to be implemented by SERCs when there were proper economic reasons for delaying tariff hikes. However, these have been used indiscriminately by SERCs, often due to their unwillingness to raise tariffs due to political pressure from the state government. As a result, RAs sitting on the books of DISCOMs total around INR 90,000 crore as of June 2023.[33] Recently, the Union Power Ministry has ordered SERCs to provide clear timelines for liquidating existing RAs and preventing them from creating newer ones, but progress on this has been slow. There is an additional fear that, since the accumulated RAs are so high, any plan to liquidate these will require large hikes in tariffs, which will not be politically acceptable.

Delicensing Distribution: Motivations, Challenges, Solutions

During her 2021 Union Budget Speech, Finance Minister Nirmala Sitharaman revealed the Central Government's intention to delicense the distribution sector, aiming to enhance both competition and the financial outlook of the industry. Following this announcement, Power Minister R.K. Singh introduced the Electricity (Amendment) Bill (EAB, 2022) on 8 August 2022.[34] The Bill is currently under review by the Parliamentary Standing Committee on Energy, which is expected to present its report to Parliament in due course.

The major amendment proposed in the Bill is related to the provision for allowing multiple DISCOMs in a single area. The EA, 2003 allows the SERC to grant licences to more than one entity to distribute electricity in the same area as long as both entities have their own distribution network. The EAB, 2022 does away with the need for licensing and allows multiple DISCOMs to operate in a single area and share the distribution network. The registration of new companies will have to be done through the SERCs; however, the SERC can only reject the application if certain eligibility criteria have not been met. Moreover, the SERC must respond within a specified timeframe; if it fails to do so, the applicant shall be assumed to have been granted the licence.

The following points summarise the key provisions of the amendment.



- **Sharing of distribution network:** A DISCOM can either use its own distribution network or that of others operating in the same area. All DISCOMs will now be mandated to provide non-discriminatory access to their competitors in the same area on the payment of wheeling charges.

- **Tariff setting:** Tariffs for DISCOMs will continue to be regulated by the SERC. In case of multiple DISCOMs, the SERC will specify a lower and upper tariff limit within which the DISCOMs will be allowed to operate. This will be necessary to allow some price differentiation between DISCOMs but will ensure that the welfarist nature of the distribution business is not completely abandoned. However, it is not yet specified what the tariff revision process will look like with the existence of multiple DISCOMs.

- **Power procurement:** In cases where multiple licensees operate in the same area, the power purchase agreements (PPAs) and cost of procuring power will be shared by the DISCOMs as per conditions decided by the SERC based on rules developed by the Central Government. New entrants will be able to enter new PPAs on their own only after existing PPAs have been exhausted.

- **Cross-subsidy balancing fund:** In areas where more than one DISCOM operates, any surplus resulting from cross-subsidy by a distribution licensee will be directed into a cross-subsidy balancing fund. This fund will be managed by a government entity, and funds will be utilised to fill cross-subsidy deficits for DISCOMs in the same area or in other areas.

Theoretical Underpinnings

Globally, the primary motivation for reconfiguring retail electricity markets is the desire to dismantle monopolies, foster competition, and empower the market to dictate prices. The overarching goal has been to mitigate excessive mark-ups imposed by monopolistic entities, thereby lowering costs for consumers and enhancing overall social welfare.

In the context of India, where tariffs are regulated, the anticipated advantages of the new amendment lie in fostering increased private involvement in the electricity sector, specifically targeting the alleviation

of inefficiencies associated with state-run DISCOMs. It is expected that heightened competition will enhance service quality and customer responsiveness, spur innovation, and refine billing and collection practices. The anticipated boost in efficiency, coupled with the imperative to compete for customers, could lead to improved financial outcomes for DISCOMs, improved services for customers, an innovative model for green power adoption, and the resolution of some of the legacy issues outlined earlier.

Across the world, the main objective of deregulating retail markets has been to separate distribution (carriage), recognised as a natural monopoly, from the supply business (content), where enhancing consumer choice through multiple suppliers is more feasible. When a single company manages both content and carriage, a conflict of interest arises, making the distribution entity reluctant to embrace competition in the retail sector. To address this, the common practice is to designate all distribution networks as common carriers, ensuring a reasonable return on investment while simultaneously opening up the retail business to consumers.

In successful instances like the United Kingdom (UK), where retail competition has led to high switchover rates among consumers, companies involved in distribution are prohibited from participating in the retail business, eliminating conflicts of interest. The proposed Indian model, however, is different as new entrants can opt to use the network of an existing operator, even if it is a direct competitor in the retail business. Despite the various provisions included in the EAB, 2022 to establish a level playing field, there remains considerable potential for conflicts of interest, introducing the risk of legal disputes that could impede the distribution segment's competitiveness. This challenge has already surfaced in Mumbai's current parallel licensing model, underscoring the need for careful consideration to ensure the realisation of goals aimed at fostering competitiveness in the long run.

The international experience with retail competition suggests mixed results concerning electricity prices. Su et al. assessed the impact of retail market restructuring on electricity prices in 17 states in the United States. Their findings indicate that the introduction of retail competition led to a statistically significant reduction in electricity prices only for residential consumers, with prices for C&I consumers remaining the same. However, this reduction proved to be transient, fading over the long term. This

suggests that, while initial competition intensification prompts greater price rivalry among competitors, this effect diminishes as underlying issues cause prices for all competitors to realign with the cost of supply. Moreover, electricity prices in retail choice states also vary more than in other states since the prices are more responsive to changes in fuel prices and other market factors.

In the European Union (EU), evidence suggests that neither the opening of retail markers nor price regulation has had a significant impact on average electricity prices, particularly for residential consumers.[35] Here, again, the evidence suggests that electricity prices in the long run tend to converge to the marginal cost of supply.

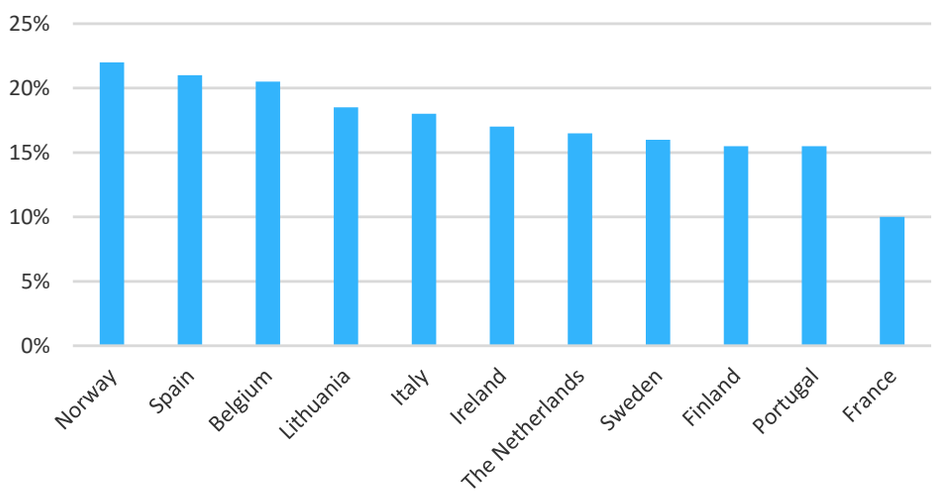
In mature electricity markets that have competition at the wholesale and retail level, distribution companies other than the incumbent monopoly (which is also the distribution network owner) can purchase electricity through the wholesale market for electricity at rates based on the consumer's load profile. However, if consumers do not participate actively in exercising their choice, it can reduce the benefits of retail choice even in mature markets. Households which are not used to retail choice may not exercise the option even if alternative suppliers offer lower prices or greener electricity. Some households may not actively seek information on electricity prices and some households may also be attached to the established monopoly supplier (DISCOMs) through which government subsidies are likely to be channelled. These sources of friction can reduce consumer gains of retail choice.

There are several examples from electricity markets in Western countries that illustrate customer inertia in exercising the power of choice in electricity procurement. In the 1980s, countries like New Zealand, the US, UK, Norway, Sweden, and Australia initiated electricity market reforms aimed at replacing monopolies with an efficient and competitive electricity sector. Success was limited, however, particularly in the retail electricity sector, where most consumers were reluctant to switch suppliers.

Norway and the UK, which were early adopters of electricity reforms, have been studied extensively. Most studies raised concerns about the competitive nature of retail markets and identified problems that were associated with a lack of active consumer participation and retail

market concentration.[36] In the mature and transparent retail market of the UK, consumers often made sub-optimal choices and switched to more expensive contracts. The British regulator Ofgem observed that the competitiveness of the market had deteriorated in several dimensions and switching rates had dropped drastically. This outcome is attributed to the highly restrictive price interventions by the British regulator.

Figure 4: Electricity Supplier Switching Rates in EU (2022)



Source: European Union Agency for Cooperation of Energy Regulators[37]

Note: Only countries with switching rates above 10% are shown.

In the Norwegian retail market, the co-existence of a highly competitive market segment with low mark-ups and active consumers was observed, along with a monopolistic market segment where suppliers exploited the consumers' passivity. In both markets (UK and Norway), the top three electricity retailers had a market share of at least 70 percent. However, product innovation was observed in contract duration, additional services, and sustainability. The key conclusion was that the transition towards a competitive and efficient retail market was dependent on the ability and willingness of individual well-informed households to actively search for and select contracts that best fit their needs.

New Zealand introduced retail competition in 1998. The main objective was to increase consumer choice, encourage innovation, and result in lower prices than would otherwise be charged. In 2009, a ministerial review of the performance of the electricity market found that consumer switching

rates were insufficient to curb non-competitive behaviour by retailers and that the full benefits of retail competition had not been realised, particularly for domestic customers. It was observed that most electricity customers exhibited a tendency to stay with their default retailers even when cheaper competitors were available. Switching promotions were organised with the creation of switching websites, which acted as one-stop-shops by offering price comparisons and allowing consumers to switch to the cheapest available supplier.

Switching websites and their extensive publicity, however, proved ineffective at increasing switching rates in most regions, even during periods of rapidly increasing retail prices, when substantial potential savings were available. Residential consumers faced rapidly increasing prices during the period 1985-2010, yet most consumers did not switch despite large price differences and the entry of new suppliers into the retail markets. The relatively low switching rates resulted in insufficient discipline on incumbent retailer suppliers, leading to higher prices.

In the early 2000s, residential electricity customers in Texas were allowed to choose their retail provider. Initially, all households were by default assigned to the incumbent. Every subsequent month, households had the option to switch to one of several new entrant electricity retailers. Though the incumbent electricity retailer's price was consistently higher than that of new entrants, most households did not switch to alternative suppliers. If households had switched to suppliers who offered lower prices, it would have saved them about 8 percent of their expenditure on electricity. Four years after the introduction of competition, the incumbent supplier's market share was over 60 percent.

Retail choice could also allow greater competition in the promotion of green power. Evidence from the US shows that retail choice states outperform others in terms of consumers that choose to participate in green pricing programs, where consumers choose to purchase renewable energy specifically, usually by paying a premium on the standard tariff. This was largely due to the more aggressive marketing of green pricing instruments in retail choice states.[38] Distributed energy resources (DER) could also benefit from greater retail choice since it can allow distribution companies to supply DER as a means for expanding their portfolios and as a means to boost

their revenue. This can be an effective way of removing the reluctance of DISCOMs to actively participate in the uptake of DER.

The other question is related to the comparative benefits of competition in the retail sector compared to the wholesale market. Although increased competition in any sector is anticipated to enhance efficiency and lower prices, that 70-80 percent of the cost of electricity paid by consumers is attributable to generation suggests that heightened competition in this wholesale sector may yield greater benefits than mere improvements in the retail segment's competition.

Indeed, well-functioning wholesale markets are a necessary prerequisite for competition in the retail segment. If companies cannot utilise the benefits of robust wholesale markets, there will be little scope for competition to innovate in terms of their tariff offerings and provide any real financial benefits. In order to create well-functioning wholesale markets, there is first a need to remove distortions in the fuel markets. Unfortunately, fuel markets in India are highly distorted due to the existence of multiple subsidies and regulatory requirements. Thus, the potential benefits from retail competition must be seen in the context of the broader electricity sector as a whole.

Challenges to Implementation

The proposed changes to the EA, 2003 are expected to have a wide-ranging impact on the electricity sector as a whole. Given the distinctive characteristics of India's electricity sector and the persistent challenges hindering the realisation of long-term reform objectives, the implementation of these amendments is expected to encounter specific hurdles. Various stakeholders have already voiced their concerns through protests, expressing apprehensions regarding the potential impact of these amendments. This section analyses some of the most crucial challenges and highlights their potential impact across the sector.

The fundamental political economy principle underlying the governance of India's electricity sector is the protection of low-income consumers from price shocks and the political imperative to increase electricity access. However, the mechanisms that have evolved and been implemented to guarantee this, from cross-subsidisation to delayed tariff revisions, have created the problem that the amendments to the EA Act are meant to solve:

debt-burdened DISCOMs that are unable to invest in the green transition, switch to more remunerative PPAs, or provide reasonable service to demanding consumers.

Further, the opaque nature of what is, objectively, a subsidy to agricultural and small household or industrial consumers, means that unexpected and possibly unfair bailouts using federal taxes have become a repetitive feature of the sector. There have been five bailouts in the past two decades; the one announced in 2023—the Revamped Distribution Sector Scheme, costing INR 3 lakh crore—will be the third such charge on the exchequer since the current Union Government took office in 2014.

It is important to note that the poor financial health of the DISCOMs has deep macroeconomic links and are relevant to policymakers taking decisions about their future structure. The indebted nature of the DISCOMs has direct financial implications not just for the federal exchequer—the source of the bailouts—but also for the banking sector and for state government finances.

DISCOM debt has to be viewed as a contingent liability of the state governments, which impacts their balance sheets in turn. The Reserve Bank of India in June 2022 warned that rising DISCOM dues mean that certain states are dangerously vulnerable to fiscal shocks.[39] The RBI warned that, if the state governments have to take over a reasonable proportion of the outstanding debt of DISCOMs and additionally infuse liquidity sufficient for them to clear their short-term dues to generation companies, the burden would represent 2.3 percent of gross state domestic product in the 18 large states. This might rise to over 5 percent in some major states, such as Tamil Nadu. Additionally, the actual debt status of many state DISCOMs is far from clear. For example, many state DISCOMs have listed payments due from subsidised consumers or groups as “recoverable” on their balance sheets when they should, in fact, be written off. These balance sheets are therefore unrealistic and misleading.

The macroeconomic implications for general government deficit and public debt of continued DISCOM ill-health are therefore considerable. What makes it worse is that the states’ methods of financing DISCOMs and of taking on additional risk are not transparent or comparable. However, most estimates are that the power sector represents more than 60 percent of the outstanding guarantees issued by state governments.

Meanwhile, for Union Government policymakers, a major issue when it comes to increasing the country's growth momentum has been the inability or unwillingness of the banking sector to lend to the private sector. This in turn has reduced private corporate investment as a proportion of GDP well below the levels seen in the high-growth years before the financial crisis of 2008. Banks have been slow to increase corporate lending because of their existing exposure, and it has taken several years of state recapitalisation to clean up their books. The level of bad loans written off in previous years, in order to bring the non-performing assets on banks' books down from 6.1 percent at the end of the 2017-18 financial year, is higher than US$125 billion. A large proportion of these bad debts were to the power sector; at the same time, in March 2018, the Union Ministry of Power believed that power capacity of INR1.7 lakh crore (approx. US$23 billion) were "stressed" assets and another possible point of failure for the banking sector.

Unfortunately for the banking regulators at the Reserve Bank of India, the clean-up of bank books has not reduced their worries over excessive exposure to the power sector being the primary point of possible failure for the financial system. In a December 2023 report on "Trends and Progress of Banking in 2022-23", the RBI noted that systemically important shadow banks have taken up the slack and the systemic risk associated with lending to the power sector.[40] These large shadow banks, or government-registered non-banking financial companies (G-NBFCs) as they are officially known, have created significant "concentration" risks in their power sector lending.

According to the RBI, the 50 largest exposures in the shadow banking sector—worth a total of INR7.8 lakh crore, or over US$100 billion—also represented 40 percent of their total corporate lending. All 50 of these were related to the power sector. In other words, the fate of the NBFC sector in India is now tied closely to large borrowers in the power sector. But the NBFCs themselves are financed through bank lending, including by public sector banks. Therefore, traditional banks are themselves on the hook for this concentrated risk, and each additional layer of complexity increases risks within the system.

From the point of view of the Union Government, therefore, there are multiple objectives to power sector reform: ending periodic bailouts; reducing direct bailouts from the federal exchequer; reducing the hidden risk and contingent liabilities of state governments; increasing the ability of

DISCOMs to buy power, thereby ensuring investment in the transition and reliability of supply; and, finally, removing a major macro-prudential risk that has the capability to bring down India's entire financial system.

It has long been understood that the essential problem in reforming the electricity sector in India is managing the political economy of a transition to tariff structures that can sustainably provide for greener, 24×7 electricity. This will require a reduction in built-in cross-subsidies and the timely adjustment of end-user tariffs closer to the actual cost of generating (or purchasing) power. Finally, any shift that allows for a more transparent understanding of who and what is being subsidised, as well as allowing for a more direct transfer of those subsidies that does not have a distorting effect on the overall power distribution system (or the banking system) is welcome.

The following paragraphs analyse the specific challenges that are understood to emerge in the implementation of proposed reform from this perspective.

- **Cherry-picking of consumers:** As highlighted earlier, electricity consumers in India can be divided into two broad categories: subsidised consumers, who benefit from lower tariffs, and higher-paying consumers, who effectively cross-subsidise the costs for the former group. Moreover, the cost of supplying electricity also differs across consumers, with lower costs for high-load consumers. Global experience has shown that, when distribution is deregulated, the new entrants that enter a particular region will always target the higher-paying, lower-cost consumers. In India, this could lead to a situation where the incoming private distribution company serves only high-paying consumers, leaving the subsidised lower-paying consumers to the state-run DISCOM. This could result in a scenario where delicensing exacerbates the financial challenges of public DISCOMs, rendering them increasingly reliant on subsidies from state governments and necessitating additional financial bailout packages.

  From the point of view of the Union Government, however, this may not be entirely problematic. It will separate the "bad" connections, users who are the recipients of subsidies, from the "good" ones. This will in turn allow for the better targeting of subsidies through the state

DISCOMs, while creating a “better” tier of service associated with the non-state DISCOMs.

The problem for the Union Government from such cherry-picking, therefore, is twofold: first, the possibility that cherry-picking will reduce the speed at which energy access is expanded to underserved households and communities; and, second, that it will cause windfall gains to private operators that are not farmed back into expanding access. Fortunately, such concerns have been addressed by institutional reform of infrastructure sectors before. In particular, the deregulation of telecommunications systems and the ending of state monopolies in the period between 1991 and 2004 had several of these features. The concern was that allowing consumers to switch away from the state-owned telecom companies—Bharat Sanchar Nigam Limited (BSNL) and Mahanagar Telephone Nigam Limited (MTNL)—would lead to cherry-picking and reduce access to the finances required to expand access. The solution proposed at the time was to create a Universal Service Obligation fund financed by a 5-percent levy on new operators, which would go into expanding telecom infrastructure in underserved areas.

Similar mechanisms seem to be adopted as a means of tackling cherry-picking in the amendment, which suggest mandating that DISCOMs must supply electricity to anyone who requests it and setting up a universal service obligation fund to share surpluses and deficits arising out of the cross-subsidy. However, the exact way in which the amounts to be deposited into the funds as well as the method for disbursement are still unclear. One concern here is that if the surplus and the deficits do not match, it will be difficult to utilise these funds to compensate state-run DISCOMs. This challenge becomes more acute when we consider that the new amendment proposes that SERC will only be setting a ceiling tariff, essentially moving away from a statutory rate of return regime. Thus, initially, new DISCOMs are likely to charge lower prices to attract newer consumers, constraining the amount of money that will be deposited in the USO fund. Moreover, while the mandate to serve all consumers is helpful, this can be avoided by DISCOMs by creating pricing models that would price out the lower-paying consumers.

It is worth noting, however, that the telecom deregulation experience is that increased private investment in the sector was by itself sufficient to increase access, including to the most remote areas and to lower-paying consumers. Replicating this in the power sector, however, would require a careful balancing between perceived profits to the new entrants in the sector and constraints (such as USO contributions) deemed important to minimise cherry-picking.

- **Higher prices for small consumers:** One of the most important reasons for public opposition to the proposed amendment has been the fear that increased privatisation will lead to higher electricity prices, particularly for subsidised consumers. These protests have been most pronounced in states with a high share of agricultural consumers, who receive the highest subsidy. This fear comes from the fact that delicensing will essentially allow more experimentation with tariffs and will inevitably lead to price rises. While this may be desirable from an economic perspective, to bridge the gap between average revenue and cost of supply, Indian electricity consumers are extremely price-sensitive. The issue of electricity prices rise is a political sore point, and this perception could prove to be the biggest political impediment to the implementation of the Bill.

  However, whether this will actually happen is unclear. The first possibility is related to the cherry-picking of consumers, whereby the new utilities might keep prices high to price out low-paying consumers, but even in this case, the subsidised consumers would probably continue to get lower rates from the state-run DISCOMs. The tariff ceiling set by the SERC will also ensure that price rises are not too rapid. However, even without any malicious intent, the global experience suggests that small consumers often do not end up with lower tariffs following greater competition. Increased private sector participation is likely to lead to more innovative tariff models including aspects such as dynamic pricing. Experience from more developed nations in Europe suggests that due to better access to information and lower transaction costs, smaller residential consumers access limited benefits from improved options. This problem will be even more severe in India as the access to information is even more inequal between larger consumers and smaller consumers. Thus, information dissemination and awareness will play a key role in the success of delicensing distribution in India.

For the government, this may not be a dealbreaker. Given that the crucial endpoint of any power sector reform is bringing tariffs closer in line to the actual cost of power, there is little doubt that higher tariffs for some smaller consumers will be seen as a benefit and not a cost. The question therefore arises why the political economy of reform would permit such a convergence now, when it failed earlier.

Policymakers may be more confident about the possibility of higher tariffs in the electricity sector following three major axes of analysis. The first is the belief that many consumers in India might be willing to pay slightly higher tariffs if it is accompanied by greater reliability in service. This has certainly been the observed outcome for households and smaller business units in some states which have seen similar reforms in the past. The current prime minister's tenure as chief minister of Gujarat, for example, was distinguished by power reform (the Jyotigram programme) that separated the feeder lines for agricultural and non-agricultural use of power in rural areas. This allowed for freeing up tariffs for non-agricultural electricity, and the observed experience was that the switch from cheaper but unreliable power to more expensive but uninterrupted electricity supply was politically popular among rural households.

The second possible axis of analysis is a comparison to deregulation in the fuel sector. It should be noted that, prior to the power sector, the main macroeconomic stressor for India has long been fuel prices. This continues to be the case for many of its peers in the developing world. Prices for diesel and petrol at the pump used to be administered, or set directly by bureaucrats. This meant that high petrol prices were seen as political poison, and state oil marketing companies were continually beset by "under-recoveries" caused by political pricing, causing them to sell fuel at lower prices than they had paid for it. The analogy to pricing within the power sector in India should be obvious.

However, since just before the current government took office, the administered pricing system (*de jure*, if not *de facto)* has been phased out. The government in turn has set fuel prices consistently higher than was previously considered politically feasible. But the level of popular or political reaction to these higher prices has been minimal by the standards of the past, or of comparable developing countries.

This will have strengthened policymakers' belief that higher tariffs are not as much of a political dealbreaker as they were in the past. When launching the most recent bailout of DISCOMs in late 2023, the prime minister very pointedly attacked "freebie" culture as the cause of such debts and clearly thought that attacking such subsidies was politically beneficial rather than harmful.

The final possible axis of analysis that simplifies the political economy of reform in this case is the availability of new mechanisms for subsidies. The complex system of cross-subsidisation, controlled tariffs, and so on that characterised India's power sector grew out of a simple inability to directly target subsidies to households and other consumers who most needed or required it. This has analogies in multiple other sectors: the public distribution system for food, for example, is the product of a period in which direct transfer benefits for food purchases were not technologically feasible. Similar problems were attached to fertiliser and liquefied petroleum gas subsidies. The latter subsidy, for LPG cylinders, has been reduced in scope considerably, thanks in part to targeting mechanisms under the PM Ujjwala Yojana, which provides free gas connections and subsidies to registered female heads of poorer households.

The scope for direct transfers of subsidies to households and other small consumers in the power sector is therefore worth considering in a way that it was not earlier. Some smaller pilot projects on this front have been tried, which have often involved directly crediting escrow accounts held by end-users but operated by the DISCOMs. This has not always panned out. One reason is that subsidy support from the government (usually the state government) corresponds to the DISCOMs' own reports of their supply to possible targets of the subsidy. These reports are necessarily incomplete and also provide DISCOMs with a clear incentive to increase the reported scale of their subsidy-related losses. Direct transfers will realign the incentives correctly. One recent study of smaller-scale efforts conducted in Rajasthan and Punjab is encouraging: 96 percent of farmers enrolled in Rajasthan and almost 90 percent in Punjab were satisfied and would recommend direct benefits to others, and it reduced consumption by farmers by 37 percent in Rajasthan and 8 percent in Punjab.[41]

- **Sharing of legacy PPAs:** Since new entrants will be allowed to utilise the network of existing DISCOMs, a big question that arises is how existing power purchase agreements will be divided between existing and new DISCOMs. Most DISCOMs in India already have existing contracts with generators for supplying power, many of which are long term; CEA statistics indicate that around 90 percent of power procured by DISCOMs is under long-term contract.

  This is likely to create several issues. First, designing an optimal method for the distribution of PPAs poses a significant challenge due to the dynamic nature of demand that DISCOMs must navigate across diverse customer segments. If the sharing of the PPA is decided simply based on the connected load of the consumers, this is likely to be sub-optimal since DISCOMs will not be able to optimise their power procurement to align with the variable nature of power demand and adapt to different circumstances. Second, if new entrants are encumbered with the conditions associated with existing PPAs, their tariffs will largely be dictated by the PPAs. Additionally, given that SERCs will also be setting a tariff ceiling, the scope for innovation in tariff-setting will become very limited. This is likely to adversely impact the appetite of private players to participate in the retail segment and can become a substantial entry barrier. Third, a constant review process will have to be established, where the sharing of PPAs will have to be relooked at every time a new entrant enters a particular area. This will increase the workload for regulators and also the risks for generators who will be exposed to continuously changing conditions for payment. Fourth, generators' payments under existing PPAs will now also be dependent upon the financial resources and credit-worthiness of new licensees, which may increase the risk they face.

  The basic political economy issue here is one of incentives when it comes to PPA sharing. The incentives of the state government or regulator will be to shift as much of the existing PPA cost onto new entrants as possible. In addition, the question of sharing new PPAs with new entrants, signed after the amendment comes into force, is open to question. This misalignment of incentives is not in keeping with the spirit of the reform, the requirements of the Union Government, or the needs of consumers. Some limits on PPA sharing will need to evolve or be introduced.

- **Impact on the appetite of the private sector:** The proposed changes in the new amendment must be seen in parallel to the existing provisions for private sector participation. As highlighted earlier, the distribution licensee model has proven an effective means to improve efficiency in reducing transmission losses and improving billing and collection. Given the limited scope to play around with tariffs, the major benefit of delicensing is also likely to be efficiency improvements. The new amendment may not sufficiently increase the overall interest of the private sector in participating in the distribution segment. This is because the potential for delicensing increases the risk for potential participants, exposing them to greater competition and complications mentioned earlier.

  For new entrants into the sector, the crucial question is how much the entry costs are, what the costs of building up a subscriber base will be, and where they may run into unfair competition with existing state-run competition. As discussed above, the question of PPA sharing needs to be resolved to ensure that initial entry costs are low. Private sector players responsible for building up new infrastructure—for example, in rural areas—cannot be treated the same as those using wires that are already in place. Entry costs in the two cases are, after all, very different.

  The cost of building up networks will depend upon whether switching costs for consumers are kept low. Here, again, misaligned incentives exist. In many other jurisdictions, an important constraint is whether a new connection can be given by a new supplier to a consumer that has an existing account and dues to the legacy distributor. Solving this issue swiftly will be essential. On the one hand, the previous supplier cannot veto a switch unilaterally by claiming outstanding dues, since this will build up perverse incentives that disadvantage new entrants. On the other hand, consumers should not have an incentive to constantly switch suppliers without paying dues. The proper reading of meters at the time of switching, and an independent decision of what is to be done about the dues, is required. Other jurisdictions have metering entities responsible for overseeing switches.

  The broader question of contract enforcement is also on the anvil. Currently, disputes between the regulatory authority and private sector

players cannot easily be recommended to arbitration, and it is well-known that the normal court system is capable of delaying dispute settlement considerably. Ensuring swifter dispute settlement will be important to keep private sector sentiment positive.

Finally, what private sector participants do not want is the notion that they are competing in an unlevel playing field. Content is separated from carriage, from their perspective, to ensure that there is open competition on content with a neutral operator of carriage infrastructure that does not discriminate in favour of the state or legacy supplier. Managing the political economy of this enterprise is essential. The state DISCOM cannot be both the unaccountable manager of the wires and competing with a private entity that uses those wires. That is a recipe for constant conflict, and one that will strongly disincentivise private sector investment. In other jurisdictions, the former state distribution companies have been converted completely to managers of the infrastructure. At the very least, separating these roles into two different entities may be required. A precedent for such exists within the public sector in India. Deregulation of aviation in the 1990s proceeded with different state-owned entities being responsible for airports and participating in the civil aviation market (as Indian Airlines and Air India). Operationally, there have been limited systemic consequences or disadvantages for private players as a consequence of this separated mandate. Meanwhile, attempts by the Indian Railways to auction off high-value train routes to private players have not really gotten off the ground. A major reason is that possible investors are aware that they will compete for customers with existing Indian Railways trains, while being dependent on decisions about tracks and routing made by Indian Railways.

- **Role of the regulator:** In a delicensed system with multiple operators in the same region, the regulatory commission must assume a pivotal role in establishing an equitable playing field for all competitors. As stated earlier, it is vital for private sector operators that the switching process for consumers be seamless and neutral. Therefore, the initial challenge lies in delineating the protocol for transitioning between distribution companies and outlining the procedures applicable to different consumers. This complexity arises from the fact that, regardless of how the protocol is defined, potential disagreements may emerge—

either from the incumbent distribution company or the new entrant—particularly if there is a perception that the switchover conditions unduly favour one distribution company over the other.

Second, the commission will have to decide tariff ceilings for different consumers while also deciding on the distribution of the cross-subsidies. This creates complications because the method for deciding a common tariff ceiling for competitors with different costs of purchasing power can be perceived to favour one over the other. Settling these disputes is complicated, as discussed above, by the problematic approach to dispute settlement in general.

The simple fact here is that state electricity regulators have been too easily captured by state governments. In fact, they clearly reflect the political priorities of specific state governments. If the broader design of electricity reform is meant to depoliticise tariff setting in order to increase entry and the space for new investment into the power system, then the powers retained by state electricity regulators will continue to be problematic. One possible answer, as carried out elsewhere, is the expansion of the regulatory zone from one state to regions or grids.

Learnings from Mumbai

Network industries, which include electricity, natural gas, rail transportation and telecommunications, consist of activities that are potentially competitive, such as generation of electricity, and ones that are naturally monopolistic, such as the transmission and distribution of electricity.[42] This combination produces a unique set of challenges to competition law and policy in designing a market structure and regulatory framework which maximise the benefits of liberalisation while effectively controlling any tendencies to monopolistic abuse. Mumbai, where parallel licencing in electricity retail was introduced, illustrates this challenge.

Parallel Licensing

The Electricity Act 2003 (EA 2003) provides for opening up electricity distribution to the private sector.[43] Section 14 of EA 2003, which allows parallel licensing, states that "the appropriate commission may grant a licence to two or more persons for distribution of electricity through their

own distribution system within the same area, subject to the conditions that the applicant for grant of licence. The grant of the licence within the same area, subject to the conditions that the applicant for grant of licence within the same area shall, without prejudice to the other conditions or requirements under this Act, comply with the additional requirements (including capital adequacy, credit-worthiness, or code of conduct) as may be prescribed by the Central Government, and no such applicant who complies with all the requirements for grant of licence, shall be refused grant of licence on the ground that there already exists a licensee in the same area for the same purpose".[44]

The core objectives of the EA 2003 were to create a power market with transparent market-driven pricing mechanism that gives consumers enough options to choose from and to provide the right policy, legal and regulatory platform to consumers to exercise their choice. Towards this end, EA 2003 introduced the concept of a distribution licensee (DL), an entity authorised to distribute electricity in a given area, and a distribution franchisee (DF), who is authorised by the distribution licensee to distribute electricity on behalf of the distribution licensee.

Parallel licensing in Mumbai was initiated not through policy or a careful reading of Section 14 of EA 2003 but through litigation over power purchase agreements (PPAs) between existing players when EA 2003 was enacted. The outcome consists of lessons on what to do and what not to do in delicencing electricity retail across India in the future. Since the introduction of parallel licencing in 2008, Tata Power Corporation - Distribution (TPCD) and Reliance Infrastructure Distribution (erstwhile Bombay Suburban Electric Supply Limited or BSES, later acquired by Reliance Infrastructure Limited [RInfra] which was taken over by Adani Electricity Mumbai Limited [AEML] in 2017), the Brihanmumbai Electric Supply & Transport (BEST), and Maharashtra State Electricity Distribution Corporation Limited (MSEDCL) have indulged in legal conflict over the interpretation of provisions in Section 14 of EA 2003.[45]

In 2008, the Supreme Court held that TPCD that was a bulk supplier of electricity in Mumbai and was entitled to supply electricity in retail directly to all consumers within its area of supply, as stipulated in its licences, following provisions of EA 2003.[46] Subsequently, the Maharashtra Electricity Regulatory Commission (MERC) confirmed TPCD as a DL for the entire city

of Mumbai, covering the licence areas of both BEST and RInfra. TPCD's distribution licence was valid up to August 2014. In 2014, TPCD secured a licence to distribute electricity for a period of 25 years effective from August 2014, till August 2039.[47] The DL covered an area overlapping the entire licensed area of RInfra, BEST and MSEDCL (legally contested).

Historically, TPCD was a power generator and bulk supplier of power in Mumbai. One of the bulk power purchasers with whom TPCD had signed PPAs was RInfra.[48] This relationship created unique challenges when TPCD entered distribution. As TPCD had access to low-cost power, it was able to offer lower tariff to consumers in areas where it was a parallel licensee. This facilitated bulk consumers and eventually also domestic consumers to switch suppliers from RInfra to TPCD. This was an intended outcome.[49] However, TPCD had no incentive to supply power to RInfra at competitive rates. This imposed additional costs on RInfra in securing PPAs with alternative suppliers. For its part, RInfra imposed wheeling charges on TPCD for transporting electricity on behalf of TPCD on its distribution network.

These issues were part of the multiple legal and regulatory conflicts between the players in the arena. The prospect of TPCD building its own distribution network (permitted by Section 14 of EA 2003), thus duplicating the existing network controlled by RInfra, was another contested issue. The result was a patchwork of temporary solutions imposed by the regulatory and other institutions such as the cost-plus mechanism for tariff determination. The cost-plus mechanism allowed parallel distributers in Mumbai to source expensive power purchased through short-term power markets and pass on the costs to the consumer.[50] As the cost of power procured through short term markets was typically higher than that of power purchased through long term PPAs, customer interest was compromised. Customers also had to bear the risk of uncertainty in tariff when a large share of the power supplied was procured through short-term markets.

Structural barriers such as limitation in transmission capacity limited low-cost power procurement from outside the Mumbai area through competitive bidding. This meant higher average tariff for consumers.[51] When regulated tariff did not permit full cost recovery, DLs transformed unrecovered costs into regulatory assets, essentially costs recoverable from customers in the future through regulated tariffs.[52] Despite witnessing significant changeover rates in the Mumbai model, consumers have experienced minimal benefits.

This is primarily attributed to substantial regulatory challenges and ongoing litigation, resulting in the actual cost of power in Mumbai remaining higher than in most other areas. This is inequitable from a consumer perspective, as consumers have to bear high and uncertain tariffs. Regulatory inadequacy reflected in incessant litigation adds to tariff volatility. This is not an outcome that one would expect in Mumbai, which has high household density (number of consumers per unit area), a distribution network that is mostly underground and reduces technical losses, few agricultural consumers, and higher household incomes compared to the rest of India, all of which contribute to lower distribution losses and greater tolerance for higher electricity tariff.

Additionally, the reliability of power has also been impacted, as distribution companies have struggled to identify sustainable long-term power purchasing options and continued investments in the distribution network. RInfra (incumbent DISCOM in the late 2000s) petitioned the MERC multiple times to take active measures to prevent the cherry-picking of high-load consumers by TPL (new entrant).[53] To resolve this, MERC intervened to establish new protocols to prevent cherry-picking, which led to backlash from the TPL and multiple court cases that had to be resolved by the Appellate Tribunal for Electricity (APTEL). For example, in 2011, taking cognizance of RInfra's claims of cherry-picking, the MERC restricted consumer migration to only those consuming below 300 units a month. However, seeing little progress on changeover rates, MERC went one step ahead and declared that all consumers below 300 units would be direct consumers of TPC.[54] Taking umbrage to this, TPL appealed both decisions. Eventually, both these orders were set aside by APTEL.[55]

The issuance of tariff orders has also led to legal tussles between the DISCOMs. In framing its tariff orders, the MERC has faced the challenge of dealing with a skewed consumer mix. Hence, it has tried to balance the tariff orders across consumers and utilities to ensure that the impact of cross-subsidies is not unduly borne by a single entity. This has led to a situation where the tariff orders have not reflected the cost of supply to companies and changeover has become lucrative only for certain consumers. However, this balancing act, continued with endless litigation between the DISCOMs, particularly TPC and RInfra. Between 2008 and 2016, all tariff orders except one were challenged in court by at least one DISCOM. This has meant that the uncertainty around tariffs has been very high in Mumbai and has limited

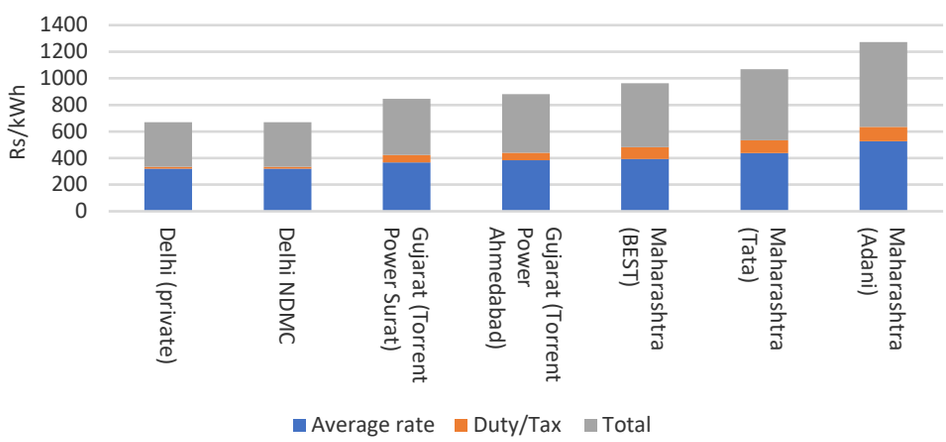
the ability of DISCOMs to provide innovative tariff models that might have benefited consumers.

Overall, the endless litigation has been a key reason that power prices continue to be high in Mumbai, translating into limited benefits from the parallel licensing experience. This highlights the need for the clear delineation of not just the principles but the specific rules for operationalising the delicensing of the distribution business. The Mumbai experiment exposes sub-optimal outcomes for customers and complex challenges for regulators who need to balance the interests of the licensees and those of the consumers and also for the judiciary that has to interpret Section 14 and related provisions of EA 2003. Despite multiple regulatory and judicial interventions since 2008, the expected outcome of competitive tariff for consumers did not materialise. In addition, issues of cherry-picking of consumers by one distribution licensee (DL) in the area served by the other, disputes over duplication of distribution networks, use of networks owned by one licensee by the other, and over cross-subsidies for use of the distribution network and issues over power purchase agreements (PPAs) continue to persist alongside other challenges.[56]

On the positive side, the Mumbai parallel licencing experience shows that the introduction of private players in electricity distribution can substantially improve financial and technical efficiency of the concerned entity. Even small improvements in economic and technical efficiency of operations of private licensees stands in contrast to persistent underperformance of state-run distribution companies that are forced to carry social burdens (sustaining employment and mediating subsidies). The annual integrated rating and ranking of power sector utilities by power finance corporation (PFC) rates distribution companies on parameters based on (i) financial sustainability (average cost of supply[ACS]-annual revenue realised [ARR], days receivable, days payable to GENCOs and TRANSCOs, adjusted quick ratio, debt service coverage ratio, leverage [debt/earnings before interest, tax and amortisation]); (ii) performance (distribution loss, billing efficiency, collection efficiency, corporate governance); and (iii) external environment (subsidy realised, loss taken over by state government, government dues, tariff cycle timelines, and auto pass through of fuel costs).[57] In the 12th annual rating and ranking of distribution companies for 2023 by PFC, six out of the top ten ranks were awarded to private companies and the top rank and rating to one of the parallel licensees in Mumbai, Adani Energy Mumbai Limited (AEML).

AEML serves 7 divisions of Mumbai city and serves over 3 million retail customers. It has no agricultural consumers, and over 14 percent of its customers are from the commercial and industrial segments. AEML had a billing efficiency of 93.7 percent and a collection efficiency of 99.8 percent.[58] Its days receivable was 17 and days payable was 38. The AT&C losses in the areas served by AEML fell from 11 percent to about 6 percent over 5 years. AEML also claims that it has increased the share of renewables from 3 percent to over 30 percent with 50,000 green tariff customers.[59] In 2023, applications of Adani Electricity Navi Mumbai (AENML) and Torrent Power Ltd (TPL) were pending before MERC for parallel licences in the jurisdiction of the MSEDCL, illustrating the attractiveness of the business for private players.[60]

Figure 5: Average Tariff in 2022 (< 100 kWh/month): Select Cities/ States



Source: Central Electricity Authority[61]

Key Takeaways

Since the introduction of parallel licensing in Mumbai, structural issues that contributed to challenges have improved substantially. There are a number of options for retail distributers to source power as constraints in transmission have been resolved. This has eliminated the need for cost-plus regulation of tariff. Overall tariff and uncertainty over tariff have reduced for domestic retail consumers but it still has a long way to go in offering competitive tariff for small consumers. Consumer experience with billing and exercise of choice has improved substantially with the introduction of new technology. Separation of carriage (wires) and content (electricity)

is yet to materialise but it is functioning in practice with the use of a distribution network common to all DLs who pay wheeling charges. The two private parallel licensees, TPCD and AEML, have no regulatory assets as of 2022, and their financial sustainability is among the best in the country.[62] However, this does not mean that parallel licencing can be implemented across the country.

Unique features of Mumbai city, which include high density with no agricultural consumers, greater incomes that can accommodate higher tariff, and a long history of private sector presence in generation and distribution that are critical to accommodating parallel licencing, cannot be replicated across the country. In many Indian states, agricultural or subsidised consumption of electricity is dominant, and incumbent distribution companies are saddled with high levels of debt. The Mumbai model demonstrates the tendency of DLs to "vertically integrate" with their own sister concerns that generate power. This has the potential to limit the benefits of competition in retail, particularly in the context of reducing tariff, as transfer pricing between related entities can be opaque. The fact that there is no fully evolved wholesale market for power procurement, along with the fact that there is no "market" for fuels (coal, natural gas, hydro, nuclear, renewables), has limited reduction in tariff, one of the key benefits of competition.

Regulation is necessary because, in most cities or states in India, no more than two or three DLs are likely to compete. This would be oligopolistic competition with limited benefits. The complexities in sourcing power in the early stages of introducing parallel licencing in Mumbai clearly highlights that wholesale competition must be in place before retail competition is introduced across the nation. In the case of Mumbai, retail competitor RInfra was dependent upon its retail rival TPCD for its electricity supply. This created a price-squeeze situation. Judiciary and regulatory interventions were inadequate for addressing price squeeze. Competition continues to be limited to a struggle for customers between privately owned and publicly owned DLs in Mumbai.

In the event that parallel licencing is introduced across the country, the arena for competition should be expanded (as the wireless telecommunications industry illustrates) to offer benefits to consumers not obtainable from regulation alone. Studies have shown that the only successful regulation

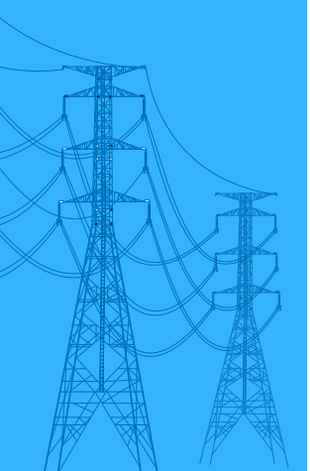
of electric utilities has been to introduce competition and competitive interaction that eliminates the need for regulation.[63] In mature electricity markets, distribution utilities exposed to true competition have lowered prices and increased sales. More crucially, their finances have met the regulatory test of attracting capital for expansion. In a number of cases, rates of return have risen and exceeded those of comparable companies not under competition.[64] The key lesson from the Mumbai parallel licensing experience is for legislators, regulators, and courts to recognise that regulation is not a substitute for competition but rather an adjunct to competition.

Distribution Reforms and Green Power Adoption

India has pledged to achieve a renewable energy capacity of 500 GW by 2030, a commitment that necessitates the installation of nearly the same amount of renewable energy capacity as its current total power generation capacity.[65] Given the intermittent nature of renewable energy, their integration into the grid and optimal utilisation of capacity will require changes to the way India operates its power grids. However, the instabilities associated with the distribution sector substantially hinder the ability to implement the structural reforms necessary to integrate renewables into the grid. Moreover, the bleak financial status of the DISCOMs compromises the ability to pay renewable generators on time, hindering long-term investment into these technologies.

Thus, the issues of improving the performance of the distribution sector and the successful deployment of renewables are closely linked. Although the retail competition amendment may impact renewable adoption, it is necessary to look at current legislative framework and instruments for green power adoption and comprehensively assess its possible impact on renewable energy adoption.

For electricity consumers in India, one of the most attractive proposals in the Electricity Amendment Bill 2014 (EA 2014, yet to become law) is the proposal to introduce consumer choice in electricity procurement.[66] Consumers presume that this will



give them the opportunity to switch from state-controlled distribution companies to private electricity suppliers just as easily as they do mobile telecommunications providers, largely based on economic value proposition offered by various service providers.

For the government and electricity regulators, creating competition for the provision of electricity can lead to lower electricity tariff in the short-run. In addition, introducing competition can create incentives to provide customers with new value-added services such as opting for green electricity. Introducing competition in electricity retail in India, however, is not likely to be as straightforward as in the wireless telecommunications sector because of unique features of electricity that require real-time matching of supply and demand. Real-time price benefits will also be muted as distributing companies are likely to purchase most of their electricity on long-term contract rather than through a wholesale market for electricity which is yet to become dominant.

Wholesale real-time markets for electricity will reflect the temporal and spatial value of electricity. Behavioural changes expected in electricity use by the consumer may not play out as anticipated without the intervention of technological inputs. If consumers are not willing to switch suppliers, deregulated retail electricity markets will not become competitive to the extent desired and may not contribute to RE adoption. These issues have important implications for the voluntary adoption of renewable electricity by consumers in India when choice in retail electricity is introduced as proposed.

Retail Electricity Sector in India

In most parts of India, consumers are connected to traditional electrical meters, and meters are read once in one or two months. Consumers pay per kilowatt hour (kWh) tariff that is independent of the actual timing of their electricity. In most regions, the DISCOM is the monopoly distributer of electricity and purchases electricity on long-term power purchase agreements (PPAs). The DISCOM does not measure the realised consumption profile of individual consumers but rather the realised total consumption profile of all consumers in a given region. This information is used by the DISCOM to make electricity purchase decisions.

As the consumer is on a traditional electricity meter, there is no incentive to adjust consumption to peak and off-peak or solar and non-solar timings as only total consumption over a month or two is recorded. Effectively neither the DISCOM nor the consumer make electricity purchase decisions on the basis of value or type of electricity at different times. The consumer does not pay more when consuming mainly at peak (non-solar hour) when electricity is more valuable rather than spreading consumption between peak and off-peak hours. As a result, the consumer consumes too much electricity when demand peaks (late evening or non-solar hours) and too little off peak (solar hours). Even without retail competition, consumers can move some of the electricity consumption to off-peak times to reduce their electricity expenditure, provided that electricity is priced according to value (more during peak hours and less off-peak hours). This will reduce overall costs for DISCOMs, and consumers will benefit from lower prices.

However, if retail competition is introduced in India as proposed, small retail consumers (households) are unlikely to switch suppliers on a large scale because the transaction costs (time and effort) are likely to be high relative to benefits. These challenges raise some concerns over the prospect of consumers adopting green electricity when competition is introduced in the electricity retail sector in India. Overall mandatory drivers of RE adoption imposed on distribution companies are likely to be stronger drivers of green electricity adoption than voluntary drivers such as climate change concerns unless private electricity distributers can offer green electricity at consistently lower tariff than traditional grid-based electricity.

Will Consumers Choose Green Electricity?

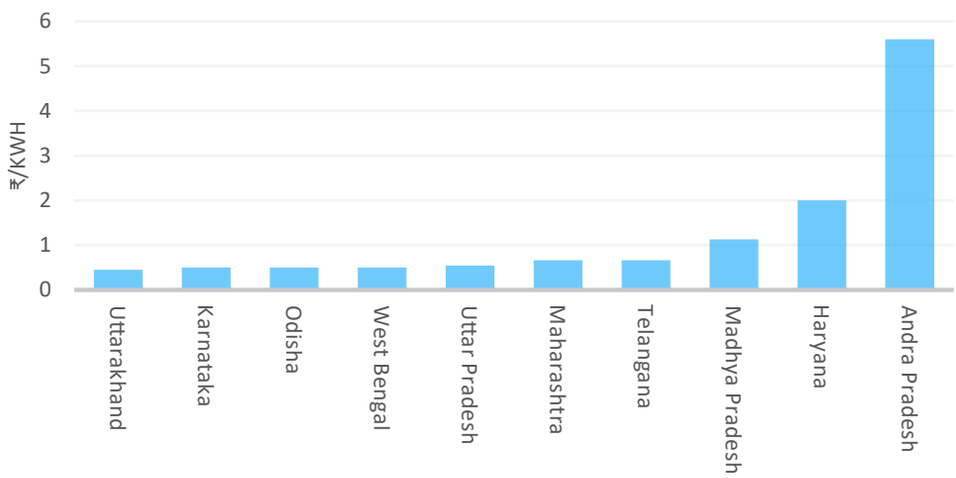
Currently, there are provisions for consumers to opt for RE electricity through monopoly distribution companies or DFs. The results so far are not encouraging, with the uptake of RE power and the number of consumers signing up for RE power being small. However, if distribution is delicensed, there is potential for dedicated suppliers of green electricity to offer RE energy products and services that are tailored to meet the preferences of the consumer. DFs and DLs dedicated to provide RE power can use the green tariff route to offer clean power to commercial and industrial consumers (C&I), who have an obligation to purchase RE power, and also to domestic consumers who want to contribute towards decarbonising the electricity sector. The green tariff option has lower transaction costs

compared to purchasing RE power through green power exchanges, opting for procuring RE power directly from RE generators using the open access (OA) provision, or setting up captive rooftop solar generators.

Green Tariff

Green premium tariff is not new, with states like Andra Pradesh having introduced it almost 15 years ago.[67] Karnataka, Maharashtra, Gujarat, and Uttar Pradesh also offer green tariff, but the offtake of RE power facilitated by green tariff remains less than 0.5 percent.[68] In all states that have green tariff, the tariff is higher than the average retail tariff of electricity, which is probably among the key reasons for limited interest in RE power offtake.

Figure 6: Green Tariff: Select States in India



Source: Mercom India Research[69]

Note: Only the green premium energy charge that is over and above regular electricity tariff is shown; final green tariff may be higher when fixed charges are included.

In 2022, the Ministry of Power (MOP) introduced the Electricity (Promoting RE through Green Energy Open Access Rules [GEOAR]), 2022.[70] As per the new rules, any consumer with a contract demand of 100 kW (kilowatt) or more can purchase green energy from their DISCOM upon payment of a predetermined tariff. A recent amendment to the rule extends this offer to customers with less than 100 kW demand.[71] For determining the green tariff rate, states must, in line with the GEOAR 2022 rules, take into account only (i) average pooled power purchase cost of the RE, (ii) cross-subsidy surcharges at 20 percent of average cost of supply, and (iii) service charges

(reasonable margin of INR0.25/kWh [kilowatt hour]).[72] The MOP is directing all SERCs to adopt the rules. If GEOAR 2022 proves to be a driver of RE power adoption, it may facilitate private DL and DFs to offer RE power to consumers when competition is introduced in electricity retail.

Two private electricity suppliers, Tata Power and Adani Electric, offer consumers in Mumbai the option of using 100 percent RE power facilitated through green tariff.[73] According to Tata Power, 27,000 consumers have switched to green power, and in November 2023, a special festival drive enlisted 6274 consumers to opt for RE power. Of the total, 3576 consumers are said to be in the 1-100 kWh category. Tata Power claims that a supply of 270 million kWh of green electricity reduced carbon emissions by 200,000 tonnes annually.[74] The green premium charged was INR 0.66/kWh over and above the normal tariff. This is half of INR 1.33/kWh green tariff calculated as per regulations. Tata Power has 762,000 consumers in Mumbai, and those who have opted for RE power account for just over 3 percent of the total.[75] This is not an encouraging number but it may be too early to come to a conclusion.

In November 2023, Adani Electricity Mumbai claimed that 3 million households and establishments, comprising over 12 million entities, were powered entirely by "clean" renewable energy sources for 4 hours.[76] About 38 percent of its consumers' electricity requirements were supposedly met from RE power. The RE power was sourced from Adani's own generation assets. This is a slightly different model of RE power adoption compared to that of Tata Power, as the decision to switch to RE power happened at the supply end rather than the demand end, without consumer involvement. Adani Electricity offers green tariff to its customers in Mumbai but details on how many consumers have switched is not readily available.

Challenges

Green pricing programmes are likely to attract C&I customers (compliance market) as well as affluent urban households (voluntary market). Green pricing provides an independent option that is voluntary and market-based to complement the carbon compliance market, including renewable purchase obligations (RPOs). In the absence of green tariff, customers who are willing to pay for RE power may lack the means to actually buy RE power. Wealthier consumers who often reflect Western preferences may

opt for green tariff to signal economic validation along with an ideological and emotional preference for RE power.

It is likely that, in a delicenced electricity market, green pricing programs will be adopted by some of the DFs and DLs to differentiate their service offering of a commodity like electricity. Green tariff is likely to remain the simplest among the many ways available for electricity customers to access RE power without investing in rooftop solar systems that carry prohibitive upfront costs or directly buying unbundled RE power through OA provisions, which carries high transaction costs.

In a delicensed downstream electricity market, DFs and DLs are likely to indulge in green power marketing through instruments like green tariff, partly to increase offtake of their own RE generation assets (as in the case of Adani Electricity Mumbai) or to meet their RPO. Green power marketing by DFs and DLs will effectively seek to develop a customer-driven market for RE power. Demand for green power is equivalent to the voluntary provision of public goods (clean air, lower carbon emissions). The experience of the DLs in Mumbai suggests that green marketing in a competitive environment is not likely, by itself, to provide a large market for RE power. This is especially true if green power commands a premium price in an extremely price-sensitive market like India. Though customers respond positively to survey questions on their preference for clean power, they are likely to hesitate when they are asked to pay higher tariffs for clean power. For example, New Delhi built gas-based power plants in and around the city in response to outcry over local pollution from affluent households. The higher tariff for imported gas-based power proved unpopular, and the two DFs that serve Delhi reverted to procuring most of their power from coal-based power plants outside Delhi. It is possible that, in the voluntary market, even affluent consumers are likely to have strong incentives to 'free-ride' and therefore will not contribute on a large scale to the provision of public goods.

There are a number of studies on consumers' willingness to pay (WTP) for green power in mature electricity markets in North America and Europe. Many of the surveys conclude that, even when 80-90 percent of those surveyed respond that they care about the environment, only about 20 percent confirm WTP for green power.[77] Most of those who demonstrate WTP for green electricity are well educated and have high incomes. When

applied to India, the share of those who demonstrate WTP in surveys among residential consumers may be much lower and those who actually pay for green power may be even lower.[78] From a policy perspective, delicensing of the retail electricity sector is not likely to drive the voluntary adoption of green power but it could be one of the many options for promoting RE power adoption. There are a number of instruments available in the current legislative and regulatory framework to promote RE adoption. These will remain vital in promoting green electricity adoption when competition is introduced in retail electricity.

Green Power Adoption: Current Legislative and Regulatory Framework

The legislative and regulatory framework provide a number of instruments for RE adoption when competition is introduced in electricity retail. Their performance under DISCOMs offers some clues on instruments that are likely to gain strength under competition.

The EA 2003 put in place a framework for increasing the offtake of power generated from variable RE sources by authorising state regulatory commissions to specify that a percentage of the total consumption of electricity in the area of a distribution licence should be RE based.[79] These along with the provision for grid connectivity from the source of generation to the consumer and open access for all generators enabled by EA 2003 provide the legal and regulatory framework for RE adoption along with competition between retail suppliers.[80] Identifying some of the drivers of RE adoption in state-owned and private distribution companies that have both succeeded and failed in increasing the share of RE could offer clues on how a competitive retail electricity market may promote RE. Competition in retail electricity may strengthen or weaken these drivers, but in the absence of counterfactual—i.e., what would be the RE offtake in the presence of competition in the retail market—it is not possible to establish a definite corelation between competition and RE offtake.

Instruments for RE Adoption

RE-based power offtake has grown since the enactment of EA 2003 but competition in the retail electricity market is yet to gather momentum. In the last two decades, state-owned DISCOMs in Maharashtra, Gujarat,

Odisha, Madya Pradesh, Uttar Pradesh, Jharkhand, and other states have attempted to adopt different versions of the distribution franchisee (DF) model. Some are operating successfully, some were aborted at the bidding stage, and others were terminated due to various challenges like non-payment of dues. Private distribution licensees (DL) in cities like Mumbai, Delhi, Surat, Ahmedabad, and Kolkata have improved operational and collection efficiency and reduced transmission and distribution losses. These DLs are often subsidised by state governments and have exclusive areas of operation that limit competition. As noted earlier, DFs in some states have used the green tariff route to offer choice to the consumer.

Resource Endowment

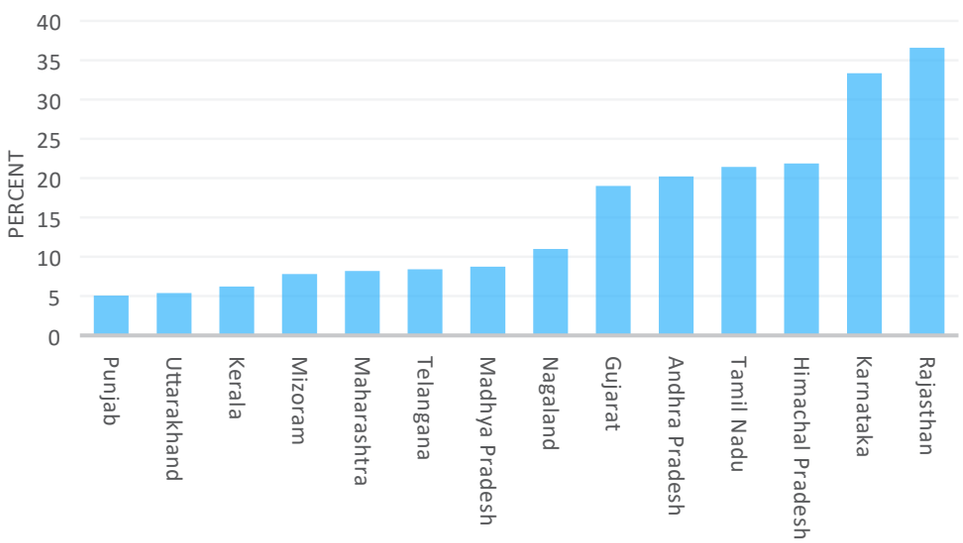
RE adoption by state distribution companies is difficult to quantify accurately as power consumption by fuel (coal, natural gas, hydro, nuclear, and renewable) state-wise is not readily available. If RE-based power generation, including large hydro, is used as a proxy for RE adoption, the "hydro rich" states of Himachal Pradesh, Uttarakhand, Sikkim, Arunachal Pradesh, Karnataka, Manipur, Meghalaya, Mizoram, and Nagaland emerge on top, as large hydropower accounted for 100 percent of power generation in each of these states in 2022-23.[81] If generation from large hydro is excluded, Rajasthan, Nagaland, Karnataka, and Gujarat come out on top. In 2022-23, over 38 percent of power generation in Rajasthan and Nagaland was from RE sources (excluding large hydro), followed by Karnataka at 34 percent and Gujarat at 31 percent.[82]

In terms of RE (including large hydro) as a percent of state electricity demand in 2022-23, Sikkim was far ahead of other states as it generated more than 10 times its electricity demand from RE, all of which was derived from large hydropower. Arunachal Pradesh and Himachal Pradesh too generated 3-4 times their electricity demand from hydropower.[83] If large hydro is excluded, "RE rich" states come out on top. In 2022-23, Rajasthan generated over 36 percent of electricity demand from RE sources, followed by Karnataka at 33 percent and Tamil Nadu at over 21 percent. As in the case of hydropower, the key driver of higher RE generation in these states is favourable wind speed and solar insolation.[84] Along with Andhra Pradesh, Maharashtra, Telangana, Punjab, Madhya Pradesh, and Kerala, these states are among the ten states classified as "RE rich".[85] In 2022-23, 80 percent of RE generation came from six RE rich states (Rajasthan, Gujarat, Tamil

Nadu, Maharashtra, Andhra Pradesh and Karnataka). On average, India's RE-rich states have a higher share of RE generation than most countries internationally.

Overall, resource endowment (water, sun, wind) is strongly corelated with RE generation. If and when competition is introduced in the retail sector, private DLs and DFs are likely to fully exploit RE endowment in a given state to strengthen their respective RE asset portfolios. However, resource endowment alone is not likely to lead to RE-based power generation and consumption. As observed earlier, green tariff is likely to be higher, and without subsidies to the consumer (demand pull) along with targets and mandates for the DL and DF (supply push), RE offtake is not likely to succeed in a big way.

Figure 7: Renewable Generation as % of Demand (Excluding Large Hydro) in 2022-23



Source: Monthly reports from Central Electricity Authority & Grid-India[86]
Note: Only states with share > 5 percent are included.

Renewable Purchase Obligations

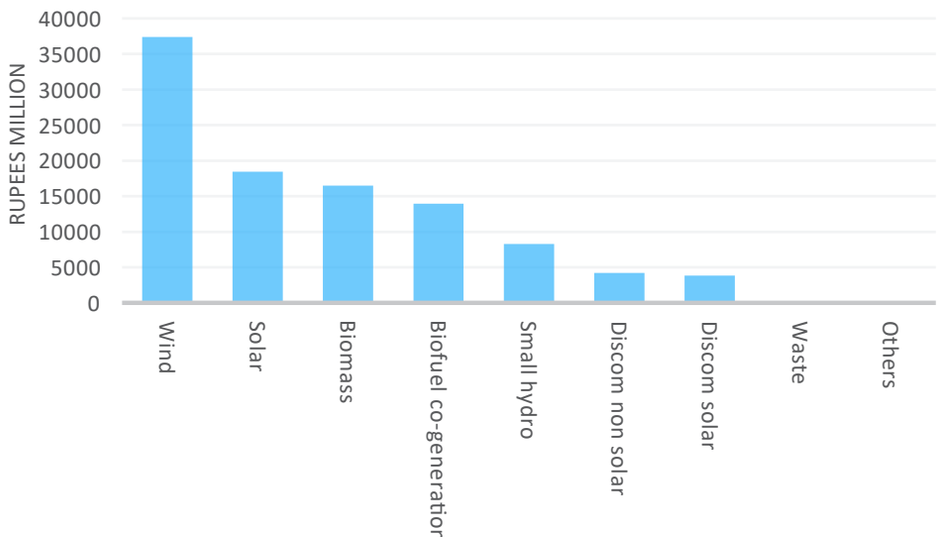
State Electricity Regulatory Commissions (SERCs) that were set up as mandated by EA 2003 imposed renewable purchase obligations (RPOs) on DISCOMs to purchase a certain percentage of electricity from RE sources.[87] With the amendment of tariff policy in January 2016, SERCs were required

to reserve a minimum percentage for purchase of solar energy to reach 8 percent of total consumption of energy, excluding hydropower, by March 2022 or as notified by the Central Government from time to time.[88] In July 2018, the Central Government notified the long-term growth trajectory of RPOs for solar as well as non-solar RE uniformly for all states and union territories, reaching 21 percent of RPO by 2022 with 10.5 percent for solar-based electricity.[89] Central Government mandated RPO share beyond 2021-22 as per MOP order dated 22 July 2022 is expected to touch 43 percent of total energy consumption by 2030. For 2022-23, the total Central Government mandated RPO target including hydro purchase obligation (HPO) is 24.61 percent. State government RPO targets are lower by at least 30 percent.

On compliance of central RPO targets, "hydro rich" states score better than "RE rich" states. In 2022-23, Sikkim led rankings with 88.4 percent RPO compliance, followed by Himachal Pradesh at 78.2 percent and Uttarakhand at 60.4 percent.[90] Among "RE-rich" states, Karnataka had the highest compliance of 46.7 percent, followed by Kerala at 36.3 percent and Andhra Pradesh at 28.5 percent. Poor RPO compliance and enforcement remain key challenges for RE adoption by distribution companies.[91]

RPOs are complimented by renewable energy certificates (RECs), a tradable market-based instrument. RECs were originally designed to facilitate compliance with RPO mandates and serve as a channel for the alternative valuation for low carbon electricity generation. Distribution companies, open access consumers, and captive power plants had the option of purchasing the REC to meet their RPO. The value of REC is equivalent to 1 MWh (megawatt hour) of electricity injected into the grid from RE sources. States like Rajasthan, Maharashtra, and Tamil Nadu that have high RE resource endowment generate RE-based power beyond the RPO targets fixed by the SERCs.[92] But states like Delhi, West Bengal and Bihar that have low RE potential generate RE-based power that is much lower than their RPO target. RECs were designed to address this mismatch. RE generators either sell RE-based power directly at preferential tariff fixed by the CERC or sell environmental benefit in the form of REC. The REC market has not lived up to expectations. Only a few states fulfil their RPO through the purchase of either RE or RECs. The failure of the REC mechanism to promote RE adoption by DISCOMs reflects the chronic non-compliance of RPO mandates that is tolerated.

Figure 8: Monetised RECs, 2022



Source: Paper presented by POSOCO at National Power Systems Conference 2022[93]

REC certification rates have fallen from their peak in 2014-15 and unsold inventory increased to over 19 million in 2023.[94] Until 2022, RECs were exchanged only in the power exchanges approved by CERC within the band of a floor price and a forbearance (ceiling) price determined by CERC.[95] The ceiling price of a solar REC has fallen by over 90 percent since 2010-12 and the price of non-solar REC by over 30 percent. Only about 5 percent of total RE capacity is REC accredited as of December 2023.[96]

Freedom to purchase RE type that best suit the load profile of a particular DISCOM or eventually by private DLs and DFs may perform better in terms of RPO targets.[97] A separate solar RPO was mandated at a time when solar prices were above INR 10/kWh and no DISCOM would have purchased it without a mandatory separate obligation.[98] Now, solar is the cheapest generation source among RE sources. DISCOMs (and DFs and DLs in the delicensed market of the future) are likely to prefer the option of merging solar and non-solar RPO and making them fungible.[99] MERC has imposed higher penalties for non-compliance and introduced incentives for over-compliance on RPO mandates. This included a reduction in annual revenue requirement (ARR) of the distribution licensees at a rate of INR0.10/kWh for cumulative shortfall in total RE procurement target for each year.[100] At the same time, MERC allowed an incentive of INR 0.25/kWh of additional RE power procured over and above the specified RPO target of MERC up to the yearly percentage notified by the Central Government till 2021-22.[101]

REC Regulations 2022, which came into effect in December 2022, aimed to restructure the REC mechanism.[102] The new regulations introduced the concept of REC multipliers by technology, increased the validity of RECs to perpetuity until sold and, most vitally, removed the floor and ceiling price for REC trading. The new rules may add to the uncertainty and risk associated with the REC mechanism in terms of technologies and policies at the state and central levels.

To improve liquidity of the REC market, the CERC recently permitted increase in REC trading windows from a monthly to a fortnightly basis for an interim period of six months. Exploring additional avenues for power trading through specialised contracts in the green term-ahead market (GTAM) / high price green day ahead market (GDAM) is leading to better price discovery for power and integration of RECs in the wholesale electricity markets.[103] There is a need to make RECs flexible enough to align with the evolving market dynamics. International Renewable Energy Certificates (I-RECs), which have emerged as an alternative to RECs, can serve as a benchmark in this regard. The attractiveness of I-RECs over RECs lies in (i) the permissibility of bilateral trading of I-RECs and (ii) the cross-border flexibility offered to market participants. Permitting international entities to participate in the REC market will enable India to harness the potential of bilateral trading in RECs, which has been operationalised in 2024.

The REC market is likely to remain constrained owing to high market and regulatory uncertainty at the state and central levels. The planned introduction of a carbon market that could potentially absorb the REC market and competition from other emission reduction solutions add to the uncertainty. More recent RE procurement methods, such as through competitive bidding, through instruments like GTAM and integrated day ahead market (or GDAM) and through the inter-state transmission system (ISTS) that waive charges, now compete with REC for RPO compliance. If competition in retail electricity is introduced, DISCOMs, along with DLs and DFs in a delicensed market, are likely to prefer the emerging mechanisms that carry greater transparency and predictability than the REC mechanism.

Open Access

EA 2003 provides for open access (OA), which is the non-discriminatory provision for the use of transmission lines or distribution system or

associated facilities by any licensee or consumer or a person engaged in generation.[104] OA is essential in retail competition in electricity as it will enable consumers to choose their preferred source of power from the open market. The eligibility criteria for OA are specified by the SERC and vary from state to state. In 2021-22, Karnataka, Tamil Nadu, Maharashtra, Gujarat, and Andhra Pradesh contributed 83 percent of India's renewable energy OA capacity addition.[105] The growth of the OA market in India is dependent on policies and the regulatory environment at both the national and state levels. Policies could both drive and deter OA growth under the current environment and also when competition is introduced at the retail level.[106]

The provisions in EA 2003 state that charges and surcharges (constituting OA charges) can be levied upon consumers opting for open access to meet the revenue loss from consumers moving away from the DISCOM supply.[107] Unlike many developed economies, in India, commercial and industrial (C&I) consumers pay higher tariffs to cross-subsidise agricultural and residential consumers through a cross-subsidy surcharge (CSS) that is levied on C&I consumers. Uptake of RE power by C&I consumers is driven by the move to reduce the high electricity costs and meet sustainability goals, such as net-zero, which is important for export-oriented industrial and commercial units. CSS accounts for 40-50 percent of landed tariff for C&I consumers seeking OA for RE power.[108] According to national tariff policy, the CSS in each state should be reduced each year, but in reality, CSS has been increasing in key RE-rich states.[109]

For DISCOMs, the tariff design that favours households and agricultural consumers precludes determination of realistic OA charges. OA charges are often insufficient to compensate for the loss in revenue for DISCOMs, but increasing OA charges makes alternative power procurement economically unviable for consumers. If charges are lowered, DISCOMs may lose high-tariff paying C&I consumers, which will have an adverse impact on their financial and operational efficiencies.

If the retail electricity sector is opened up to competition as proposed, OA consumers switching between DISCOMs and alternative supply sources will have an impact on DISCOMs' power planning and scheduling, leading to penalties in the form of deviation settlement mechanism (DSM) charges. On a broader scale, this will have an impact on energy security at the local level (24-hour dependable supply of power 365 days of the year).

RE adoption has been supported by wheeling electricity, the process of transmitting electricity from an RE generator to a user in the same balancing area, and banking RE service, which allows generators (such as rooftop generators) to put all their generation on the grid when generators do not require it (such as during the day) and use banked grid-supplied electricity when generators need it (such as at night). However, wheeling and banking agreements (WBA) are also fraught with challenges for DISCOMs and consumers.

The case of Karnataka, which tops the ranking of RE adoption, is illuminating in the context of implementing OA and related policies. In 2022-23, RE generation (excluding large hydro) in Karnataka was over 34 percent of total generation and over 33 percent of electricity demand.[110] Since 2016, week-ahead and day-ahead scheduling of wind and solar generation were institutionalised under the forecasting and scheduling regulations of the Karnataka Electricity Regulatory Commission. Procedures and processes around metering and billing, especially for OA and captive consumers, were codified for 1 MW and above consumers.[111] OA sales increased by 52 percent between 2016 and 2019 in Karnataka.[112] The solar policy of Karnataka 2014-21 granted a 10-year exemption on all grid charges for OA solar projects commissioned until 2017-18. With the end of the incentives, RE OA installations fell by 75 percent year-on-year.[113]

RE capacity with WBAs increased from 182 MW to 3,492 MW from 2010-11 to 2021-22 in Karnataka. While RE capacity with WBA grew 17 times and RE procurement prices fell dramatically, the concessional WBAs for RE has remained unchanged. According to calculations in a study carried out by Prayas for Karnataka SERC, concessional WBA resulted in DISCOMs and DFs foregoing revenue of INR 334 crore and INR 368 crore in 2019-20 and 2020-21, respectively.[114] Transmission charge waiver accounted for foregone revenue of INR 530 crore and INR 630 crore, respectively. These financial burdens are ultimately borne by rate (electricity tariff) payers and taxpayers (when subsidised), which is a matter of concern for states that are focused on consumer-related issues but not for the centre, which is focussed on meeting multilateral targets and in increasing private sector participation.

The Green Open Access policy, issued in June 2022 (GOA 2022), could improve RE adoption depending on how it is implemented by DISCOMs and

when retail competition is introduced by DLs and DFs. It is very likely that private sector DLs and DFs will push for clarity on OA and banking charges which, in turn, may facilitate RE adoption by C&I consumers. The policy provides long-term clarity regarding OA charges and banking and reduces the eligibility limit to make GOA 2022 more accessible to C&I consumers. GOA 2022 specifies the appointment of a Forum of Regulators (FOR) to decide on a standard methodology for determining all OA Charges.[115]

Payment Security

Instruments put in place for payment security to power generators is likely to incentivise production and sale of green power to DISCOMs, DLs and DFs. Privately held DLs and DFs with efficient financial management will be in a position to procure green power at favourable terms compared to state-owned DISCOMs. According to CRISIL, leading RE companies were expected to see their receivables reduce to ~140 days as of March 2023 from ~180 days a year ago, a level last seen before the pandemic began.[116] Two-thirds of this decline was attributed to increasing central counterparty offtake, and the rest due to state DISCOMs implementing the late payment surcharge (LPS) scheme.[117] Payment profile of state DISCOMs is often variable and unpredictable, which leads to additional working capital costs and creates cash flow management issues for RE companies. The LPS scheme was expected to clear dues of ~INR 2000 crore 2022-23.[118] This potentially helped improve investor sentiment in the sector, who take confidence on payments from counterparties as per terms of power purchase agreements, albeit with some delays. A fundamental improvement in the financial and technical health of state DISCOMs is imperative for long-term sustainable development of the RE sector.

Foreign investors face a significant barrier to investing in RE in India because of off-taker risk. Off-taker risk is a key contributor to the overall credit risk of a power project. The payment security mechanism is an effort by the government to manage off-taker risk. Lower off-taker risk will attract investment in RE generation and in turn increase RE adoption in both a monopolistic electricity retail environment and also in a delicensed retail environment.

The DISCOMs of Rajasthan and Tamil Nadu that are among the top three RE generators are rated poorly on financial sustainability and economic

efficiency in the annual integrated rating of power distribution utilities brought out by the Ministry of Power (MOP) for 2021-22.[119] The three DFs under the DISCOM of Rajasthan are ranked 19th, 29th, and 39th out of 57 distribution companies with C and C- ratings, while the DISCOM of Tamil Nadu is ranked 49th with a C- rating and a cautionary "red card" indicating precarious financial status. The DFs under the DISCOM of Gujarat however are ranked among the top 10 distribution companies with an A+ rating. The electricity distribution companies of Karnataka, the top-rated state in terms of RE generation and offtake, hold ranks below 15 in the national tables with A and B- ratings.[120]

In June 2022, the Ministry of Power (MOP) notified the Electricity LPS (late payment surcharge) and Related Matters Rules, 2022. This was based on subsection (1) of Section 176 of the EA 2003 that gives the Central Government powers to make rules by notification with the goal of carrying out the provisions of EA 2003. The rules provide a mechanism for the settlement of outstanding dues of DISCOMs to generating companies, inter-state transmission licensees, and electricity trading licensees. Under LPS, all outstanding dues, including principal and late payment surcharge, are clubbed into a consolidated amount that can be paid in interest free equated monthly instalments (EMI). The number of EMIs depends on the quantum of outstanding dues with the maximum number of EMIs standing at 48. One-time relaxation is given to all DISCOMs, under which the amount outstanding (includes principal and LPS) on the date of notification of the scheme is frozen without further imposition of LPS.[121] Non-payment of dues by DISCOMs, one month after the due date of payment or two and half months after the presentation of power bill, whichever is later, shall attract regulation of power as laid down in the LPS rules, 2022. Regulation of power could mean, at the extreme, complete withdrawal of power supply by generating companies and phased reduction in access to transmission.[122] Power Finance Corporation (PFC) is the nodal agency for implementing the rule. The liquidation of outstanding dues in a phased manner without imposition of LPS is expected to give DISCOMs time to improve their finances.

Barring a few states, most DISCOMs were reportedly complying with LPS rules especially because access to traded power was reduced by 25 percent along with a reduction in supply of power to DISCOMs that did not comply with LPS rules. Outstanding dues of DISCOMs to generating

companies declined sharply in August 2022 as strict penalties on defaulting DISCOMs were enforced. However, the payments made by DISCOMs to avoid harsh penalties was facilitated primarily by funding from PFC (Power Finance Corporation) and the REC (formerly Rural Energy Corporation, now REC Ltd) adding to the debt liability of the DISCOMs. Once LPS rules were put in place, REC and PFC, both state-owned non-banking financial institutions focused on the power sector, were advised to lend over 1.2 lakh crore to DISCOMs.

LPS rules may eventually bring significant improvement in liquidity and also in creation and maintenance of payment security mechanism. As the LPS equalises the status of all players in the value chain with rules applicable to all generating companies including independent power producers, RE generators and transmission companies (TRANSCOs) it will eliminate the DISCOM practice of paying only those entities that were under regulatory supervision. Earlier, the benefit of regulation of power was available only where the PPA or transmission agreements explicitly included regulation of power access as a payment security. The elimination of differentiation will substantially improve receivables and the liquidity position of all generators. Enforcement of LPS rules may also ensure that the power sector attracts required investment. In the context of RE adoption, the LPS rules could lead to a significant cash inflow for RE developers. According to CRISIL, the scheme could release INR 9000 Crore for RE developers over 2022-24. This could positively impact the receivables period of leading RE generators, reducing it from the current 180 days to 40-50 days by March 2024.[123]

Most solar power procurement in Indian solar projects is managed by the Solar Energy Corporation of India (SECI), a central government agency, while power purchases are done by state DISCOMs to meet their RPO targets. As observed in most solar PPAs, the solar tariff discovered in state-level solar PPAs is typically about 15-20 percent higher compared to SECI solar bids reflecting payment risk by state DISCOMs. DISCOMs are the purchasers of over 80 percent of the solar power generated in the country.

As part of payment security in SECI solar bids, a monthly unconditional revolving and irrevocable letter of credit (LC) is issued by SECI to the solar developer. SECI has an INR 500 crore payment security fund to protect its bidders.[124] Payment security in state-level procurements is done by revolving LC backed with DISCOM or state government assurances which

do not suffice to meet the financial closure in the event of payment default by the off-taker.[125] The one-month revolving LC is a very short backup period as part of payment security, and developers generally demand for a 12-month revolving LC to be renewed thereafter. The buyer of power from the Rewa Ultra Mega Solar Power Project adopted this method.[126]

In the case of RE procurement by state DISCOMs and in the future by DFs and DLs in a delicensed retail market, there is a need to back up the payment security through a tri-party arrangement. For example, in the case of the Rewa Ultra Mega Solar Project, the MP government extended a counter-guarantee for payment security through LC as well as the creation of a payment security fund backed by the assurance of the state government.[127] In the case of the SECI procurement, there is an LC, payment security fund, and a tri-party agreement with GOI, RBI, and state governments who are the ultimate buyers of power. While the SECI has an AAA-rated credit rating, most of the DISCOMs are rated much lower, which exposes the RE developer to credit risk. Payment security mechanism will be a critical driver of RE generation and adoption when competition is introduced in electricity retail. RE generators are likely to ensure strict enforcement of the payment security mechanism on incumbent DISCOMs, DLs, and DFs which, in turn, will increase the financial sustainability of RE generators. This in turn will create an environment favourable for accelerating RE adoption by consumers.

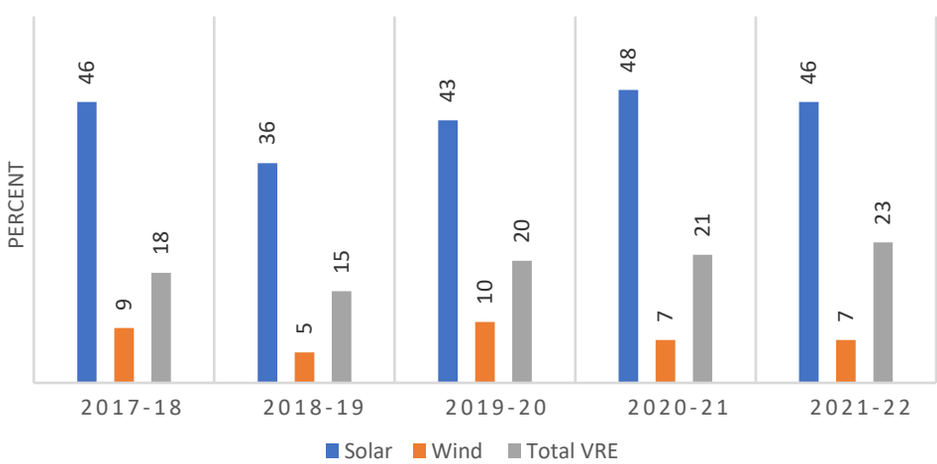
Resource Adequacy Planning

Major challenges of decarbonising the electricity grid include increasing grid flexibility and keeping grids reliable. This requires changes in resource adequacy planning. In consultation with the Central Electricity Authority (CEA), the Ministry of Power (MOP) issued guidelines for Resource Adequacy (RA) Planning in 2023.[128] The key guidelines include DISCOMs' and eventually DLs' and DFs' responsibility to ensure 24×7 reliable power (load shedding is not an option). Distribution companies (DISCOMs, DLs and DFs) are expected to have a mix of long/medium/short-term power procurement contracts at least cost. Over-reliance on the electricity market is to be avoided and compliance with Nationally Determined Contributions (NDCs) is expected from distribution companies.

Distribution licensees are expected to draw up the demand profile; demand growth rate; and present contracted capacity and quantity being procured from power exchanges on a planning horizon of 10 years on a rolling basis.[129] The RA plan will lay down the quantum and type of resources required in the distribution portfolio to meet the demand in a least cost and secure manner and give YoY optimal generation and storage capacities required to meet the system demand and planning reserve margin.[130]

In general, resource adequacy ensures energy (electricity) security which means provision of electricity 24 hours of the day 365 days of the year. The current method used by DISCOMs for RA planning is to calculate capacity addition to meet peak load and energy requirement based on simple extrapolation-based models which have resulted in an oversized system. A cost-effective approach to meet forecasted demand at all times with a mechanism of sharing of resource among states to maximise utilisation needs to be developed through a framework with a focus on ensuring reliable grid operations. The responsibility of RA planning rests with DISCOMs, and in the projected future, the responsibility will also fall on DFs and DLs. Distribution companies will need to develop rolling five-year plans and one-year firm plans for RA in an environment where the share of RE generation is high. The RA plan must include capacity credit (CC), which is the amount of power it can provide during peak hours to ensure reliable grid operations. Planning reserve margin (PRM), which is the percentage of resources in the system available over and above the peak demand, must be factored in to ensure sufficient resources for reliable grid operations.

Figure 9: Historic Capacity Credit for the Western Region



Source: Forum of Regulators[131]

Demand assessment and forecasting is a crucial step of RA planning analysis. It involves forecasting of peak demand in megawatts and energy in terawatt hours for multiple horizons (short-, medium- and long-term). The forecast should consider various input parameters such as historical consumption, consumer categories, weather data, econometric data, policies, and other demand drivers. Long-term demand forecasting is typically undertaken to economically plan the new generating capacity and transmission networks over 10-20 years.[132] Medium-term demand forecasting is undertaken for the scheduling of fuel supplies, maintenance programs, financial planning, and tariff formulation for up to 5 years.[133] Short-term demand forecasting is for planning start-up and shut-down schedules of generating units, reserve planning, and the study of transmission constraints over 1 day up to 1 year. Generation planning is set to become more complex, as larger amounts of variable RE (VRE) generation is added to the system, which is dependent on the weather.[134] It is important to determine the contribution of these VREs along with energy-limited resources (such as hydro and storage) towards resource adequacy requirements.

When competition is introduced in the retail segment, DFs and DLs are likely to invest in cutting-edge technologies and skilled manpower for RA planning.[135] This will optimise investment in generation assets and in contracting for long-term and short-term power procurement. Better forecasting and planning by DFs and DLs operating in a delicensed retail market can leverage zero marginal cost-generating sources such as solar to optimise costs that will lead to lower power tariff for consumers. This, in turn, can promote RE adoption.

In mature markets with well-developed wholesale and retail markets for electricity, the introduction of zero marginal cost RE has resulted in declining wholesale electricity prices and increasing retail price for electricity because of the grid integration costs of VRE. The expectation is that technology innovation will outpace policy innovation and enable generation, heating, cooling, and storage solutions to interact with smart homes, smart meters, electric vehicles (EVs), and peer-to-peer electricity trading to provide the real-time matching of supply and demand. In India, the introduction of DLs and DFs with sophisticated management and access to financial resources in electricity retail may increase the scope of leveraging technology for greater RE adoption.

Prosumer Model

Draft amendments to the EA 2003 in the EA 2014 suggested, among other things, the separation of carriage and content towards the goal of increasing consumer choice in electricity procurement and promotion of RE based electricity consumption. Separation of carriage and content meant separating the distribution and supply function that was expected to promote competition in electricity retail. RE-based electricity promotion in EA 2014 included a number of incentives at the supply end along with complementary provisions at the demand end. Under EA 2014, RE-based electricity generation and supply would not require a licence, and cross-subsidy for OA would be eliminated.

EA 2014 is yet to become law and provisions of EA 2003 that were prerequisites for introducing competition at the retail end have not yielded expected results. OA is faltering because of high cross-subsidies and lack of infrastructure. Parallel DL model has also failed to pick up as it requires distribution companies to distribute power "through their own distribution system within the same area." This means duplication of capital-intensive infrastructure leading to higher costs. The DL model adopted in Mumbai stands testimony to this outcome.

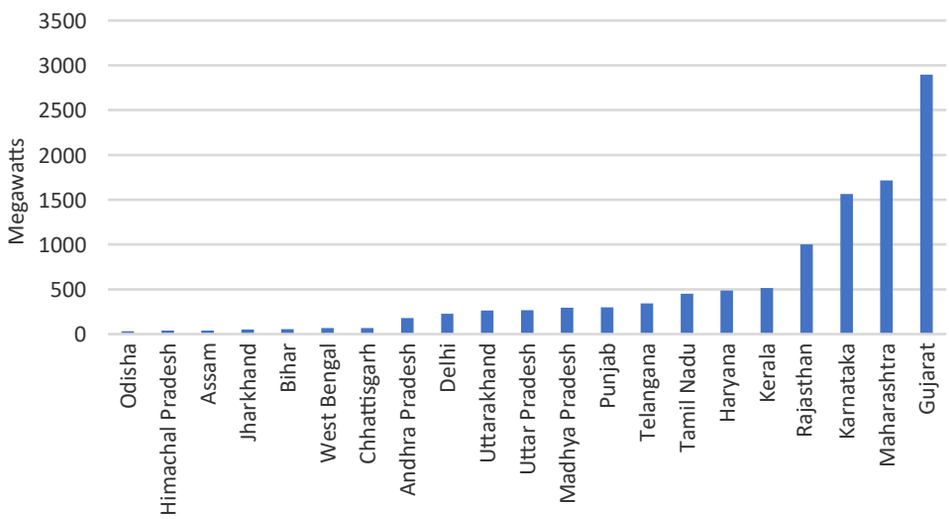
In this context, distributed production and consumption of RE by households and industries primarily using solar photovoltaic (PV) systems is projected as a potential driver of RE generation and consumption. In 2023, the cumulative capacity of rooftop solar PV installations was around 10 GW (gigawatts), which was about 7.5 percent of total installed capacity of RE and 13.8 percent of total solar installed capacity in November 2023.[136] In India, over 75 percent of rooftop installations are by C&I entities. Those with solar rooftop installations are both producers and consumers of RE and can drive RE adoption with the support of the right infrastructure and financial incentives provided by DISCOMs, DFs and DLs.

Incentives for Prosumers

Prosumers are end-use consumers of electricity who also produce their own electricity at the point of consumption to meet their own electricity needs and export surplus electricity to the grid. Increasing the number of prosumers could increase RE consumption and also substantially reduce

transmission and other system losses. These potential benefits are particularly important at the city level, where a large share of electricity is consumed and where consumption is set to rise with rapid rates of urbanisation. The major policies that enable development of prosumers are capital subsidies for installation of solar PV systems, net-metering and feed-in tariffs (FiTs) and more recently by the Pradhan Mantri Suryodaya Yojana (PMSY), a Central Government scheme that aims to provide electricity to low and middle-income individuals through solar rooftop installations.[137]

Figure 10: Rooftop Solar Installations, 2023[138]



Source: Ministry of New & Renewable Energy [139]
Note: Only states with installed capacity above 10 MW are shown.

Capital subsidies allows middle-class households and small commercial and industrial entities to adopt solar rooftop systems. Net-metering, which is the most lucrative billing system for prosumers, allows customers (residential, commercial and industrial) who generate their own electricity from solar power to feed electricity they do not utilise into the grid. Under net metering, the value of electricity that the prosumer feeds into the grid is the same as the value of electricity the prosumer imports from the grid. The bill calculation is based on the net value. The net present value (NPV) of a net metered system is high; a prosumer under net metering does not require investment in a storage system, and a solar PV system with net metering has a short payback period. In India, policy on net metering varies from state to state. Net billing is similar to net metering except that the tariff of electricity exported to the grid is lower than the tariff charged for

electricity used from the grid. In a gross metering system, the prosumer does not directly use electricity produced by solar panels. Instead, the electricity produced is exported to the grid, at a fixed rate (FiT), and the prosumer draws electricity at the tariff charged by the DISCOM, DL or DF, like most other consumers. Though gross metering reduces the prosumer's savings, it offers an incentive to the DISCOM to induct prosumers into the distribution system. From a purely economic perspective, net metering could overvalue the prosumer's electricity supply, but from a climate action perspective, this valuation may be justified on the grounds that it promotes decarbonisation of the electricity grid.

Challenges for Prosumers

There are many barriers to the expansion of solar PV prosumerism in India, including high initial costs, insufficient support mechanisms and legal frameworks, resistance by incumbent DISCOMs to provide support, inadequate levels of training and skill of technology providers, poor information, and a host of administrative or financial barriers. Subsidies for the production and use of solar PV can overcome these barriers, but there are limits to subsidising RE adoption, as the case of Spain shows. In the late 2000s, Spain implemented generous support for RE adoption. Under the support mechanism, the prosumer was able to choose between selling electricity generated with solar PV under a FiT mechanism or sell it in the free market that offered market price plus a feed-in premium.[140] This increased solar rooftop adoption substantially. However, in 2012, this support scheme was suspended as payment to prosumers exceeded expectations. In 2016 and 2017, the government called for technology-agonistic RE auctions. Wind power won as it sought no additional premium apart from market price. In 2015, Spain imposed a "sun tax," under which systems up to 100kW (kilowatt) were not allowed to sell surplus electricity to the grid and systems above 100 kW required registration to sell to the spot market.[141]

The speed and degree of prosumer growth may be influenced by several economic and non-economic factors. In India, the growth of prosumerism could be motivated purely by the economic self-interests of end-users to reduce their costs of energy and constrained only by defined limits to logistic growth of technological expansion. Affluent urban households could initiate grassroots movements motivated by increasing urgency

for climate action, facilitating neo-communal prosumerism. Other drivers for export-oriented services and industries to become prosumers could include the compulsion to turn green to navigate trade barriers imposed by developed countries. The PMSY programme can also introduce challenges as it is promoted as a means to reduce electricity bills to zero and serve as a means of generating income by selling electricity to the grid.

Increase in the number of prosumers in the electricity system will bring a host of challenges to DISCOMs and also to DLs and DFs in a delicensed market. The most significant is loss of revenue while maintaining investment in grid security and stability. The impact of a growing number of prosumers on reliability and resilience raise concerns. This means additional investment in monitoring, forecasting, aggregation, automation, and control. This is a financial challenge for DISCOMs, DFs and DLs.

A recent paper reviews the idea of a "death spiral" for DISCOMs, where electricity consumers self-sort to become prosumers, thereby leaving consumers who are financially unable to convert to prosumers to bear increasing energy costs and pushing more consumers to become prosumers, which drives the price up further.[142] In India, the poor who lack proper homes with roofs, home renters with no access to space for PV systems, and those who cannot afford PV systems would have to bear the cost of prosumerism. Research on the Spanish case found that most prosumers will not disconnect from the grid even when they have installed backup systems and are able to meet their consumption needs comfortably when the incentive system for selling green electricity to the grid are attractive.[143]

Prosumersim is in a nascent stage in India. This provides an opportunity for India to weigh the costs and benefits of prosumerism and adopt a model that is relevant for Indian social and economic conditions. Given that residential PV generation is much more expensive than utility-scale PV generation, the subsidy cost per-kWh of residential PV generation is substantially higher than the per-kWh subsidy cost of utility-scale PV generation. There is no compensating difference in benefits and thus there is simply no good reason to continue to provide more generous subsidies for residential-scale PV generation than for utility-scale PV generation. Policies for supporting RE generation and consumption need not offer higher subsidies for rooftop residential PV systems than utility-scale PV generation. In a delicensed

retail market for electricity, DLs and DFs will want to recover distribution costs that reflect network users', particularly prosumers', impacts on those costs. This will increase tariff for RE and potentially discourage RE adoption by consumers who are not prosumers. Prosumerism may also provide opportunities for DLs and DFs in a delicensed retail electricity market to aggregate solar PV generation to distribute the costs and benefits between consumers and prosumers. This in turn may increase RE adoption as it will reduce the transaction costs of installing and managing rooftop solar systems. DLs and DFs can also offer renewable energy service company (RESCO) model contracts to prosumers. RESCO is a zero-investment model in which the consumer pays only for the electricity generated, while the solar plant is owned by the RESCO developer.

Conclusion

Theoretical expectations of RE adoption in a delicensed retail market for electricity are contested by the sobering real-life experience of open access and multiple DLs in the case of Mumbai. Competition in electricity retail in Mumbai has not necessarily promoted RE adoption in a big way nor has it resulted in lower tariff. There could be a number of technical issues behind the challenges in RE adoption, but at a broad level, the mismatch between the perspective of the Central Government and state governments could be among the key reasons. The Central Government has a long-term international perspective focused on meeting multilateral carbon reduction and efficiency targets and in making the sector attractive for private participation while the states are concerned with more immediate issues of protecting DISCOMs' revenues and maintaining affordable tariff for low-income consumers. In addition, centralised legislation and regulations that follow a one-size-fits-all approach do not necessarily suit distribution companies with different motivations and capabilities that serve a wide range of consumers, most of whom have limited ability to pay.

DISCOMs of the three top performing states in terms of RE adoption in 2022-23 were state-owned DISCOMs, though some had outsourced customer end operations to a DF. This suggests that ownership and operating model are not critical for accelerating RE adoption.

Studies have shown that privatisation, competition, and regulation, though desirable, do not yield positive results if they are implemented

simultaneously.[144] Both theoretical and empirical literatures have pointed to the importance of competition in raising economic efficiency during privatisation. According to Joseph Stiglitz, Nobel prize-winning economist, successful economic programs require extreme care in sequencing, i.e., the order in which reforms occur.[145] Recent empirical research on reform in developing countries has concluded in favour of gradualism, which emphasised the importance of first establishing institutional infrastructures conducive to market forces, including setting up competitive industrial structures and appropriate regulatory systems. A study based on a panel dataset covering 25 developing countries for the period 1981-2001 found that establishing an independent regulatory authority and introducing competition before privatisation was corelated with higher electricity generation, higher generation capacity and improved capital utilisation.[146]

An earlier study that used a larger dataset involving 51 developing countries over the period from 1985 to 2000 found that competition was more important than privatisation in raising economic performance in electricity generation.[147] Evidence from industrialised Western economies, including the UK, show that privatisation alone is insufficient to stimulate performance improvement, especially in public utilities with natural monopoly characteristics. In the Indian case, primary fuel markets are regulated and wholesale electricity markets are not dominant. Introducing competition at the retail level when competition is absent in the rest of the value chain may result in sub-optimal outcomes not only in RE adoption but also in economic and technical efficiency.

The Way Forward

The proposed amendment to the Electricity Act aimed at the delicensing distribution and separation of carriage and content comes at a time when improving the performance of the distribution segment is critical for creating a reliable power sector capable of scaling renewable energy but also as a means to reduce fiscal risks for the whole economy.

However, the potential implication of delicensing must be assessed in relation to the broader historical attempts to reform the electricity sector. In this study, we have aimed to highlight some of the key challenges that are likely to arise in the implementation of a delicensed distribution regime. In each section, we also highlighted actions that can be taken to tackle these implementation challenges and ensure that delicensing can maximise benefits for the distribution segment. Table 3 provides a summary of the recommendations.

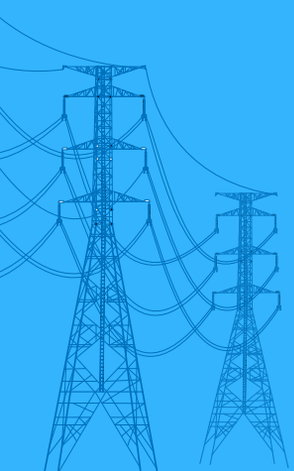


Table 3: Summary of Recommendations

Challenge	Recommendations
Ensuring pricing flexibility	• Accelerate reform of wholesale electricity markets and fuel markets to realise the full benefits of retail competition • More ambitious price floors and ceilings that account for the actual cost of supply • Consider graded pricing structure, with different floors and ceilings for consumers with differing power loads
Preventing cherry-picking and ensuring energy access	• Establishing precise USO fund criteria is crucial. This includes entry levies for new entrants to aid future profitability assessment, adjusting levy size to prevent consumer targeting, and ensuring that withdrawals expand services in underserved areas. • SERCs will need to set up a system to observe pricing mechanisms being deployed by new private entrants to ensure that discriminatory pricing models are not applied to selective consumers.
Ensuring benefits for small consumers	• Direct benefit transfer will be needed to protect small consumers from sudden price rises. The cherry picking of consumers can be used as a means to target subsidies to specific consumer groups that lack the ability to pay higher prices for better services. • Local governments to carry out awareness campaigns to inform all consumers of new DISCOMs entering an area. • Centralised online platform should be developed to allow consumers to compare all offerings across different DISCOMs in their area. • SERCs will also need to build capabilities to monitor targeted advertisement from new entrants which are only focused on specific consumer groups.

Creating a level playing field for new entrants	• Separating the roles of state DISCOM in the content and carriage business. There is a need for creating separate entities to manage these two separate roles to avoid conflicts. • Devising a standard method for PPA allocation that must be followed by all DISCOMs to prevent SERCs creating conditions that favour incumbent state DISCOMs. • An effective contract enforcement mechanism is crucial to prevent delicensing from resulting in prolonged litigation, which could unfairly disadvantage new entrants. • Need to establish clear criteria for consumer switching. In particular, there is a need for an assigned entity to carry out accurate meter readings at the time of switching and provide independent assessment regarding the handling of outstanding dues.
Enabling green power adoption	• Renewable Purchase Obligation (RPO) targets should be technology-neutral, enabling DISCOMs to select renewable energy sources that align optimally with their load profiles. • Allowing for the use of International Renewable Energy Certificates (I-RECs) could provide greater flexibility for private DISCOMs to utilize RECs for meeting their RPO targets • New renewable energy (RE) procurement strategies, such as the Green Term-Ahead Market (GTAM) and the Integrated Day Ahead Market (GDAM), along with the use of the inter-state transmission system (ISTS) should be enhanced to offer more choices for private DISCOMs to procure renewable energy.

As a starting point, we assessed the progress on improving competition in the distribution segment as envisaged in the EA, 2003. Significant strides have been made in unbundling the electricity sector, yet progress on improving competition in distribution has witnessed hits and misses. Notably, when the private sector has participated effectively, there has been a substantial improvement in reducing the AT&C losses of distribution

companies. The central issue however continues to persist: the private sector remains hesitant to engage in the distribution business for the same reasons that the financial position of DISCOMs has also deteriorated despite multiple attempts at reform. In particular, we identify three issues that need to be resolved to improve competition and financial performance of the sector: i) improved methods for framing tariffs that better capture the variable cost of supply; ii) regular upward tariff revision; and iii) phased reduction of the cross subsidy.

The question now is whether the separation of content and carriage can resolve some of these issues. We highlight that, based on global experience, improving competition in the retail business can lead to better convergence in tariffs and the cost of supply. In India, this would mean an increase in the electricity tariffs for residential and agricultural consumers and a reduction in cross-subsidies, assuming that the ceiling provided by SERCs would allow this. If this is the case, it could lead to the improved financial position of DISCOMs. However, this could also be a key political impediment to implement the Bill, as witnessed by protests against this issue.

Alternatively, as witnessed in other countries, improved private sector participation can lead to cherry-picking by new private players that can choose to design their pricing in order to attract only high-paying customers, leaving state DISCOMs to supply to consumers with lower ability to pay. This can, however, provide an opportunity to identify consumers who actually need to be subsidised, leading to the better targeting of Central and state government subsidies that are currently provided to DISCOMs for a broad set of residential and agricultural consumers. Essentially, consumers within this group that are willing to pay higher prices for improved services could potentially be excluded from the subsidy basket.

We also expand on major implementation challenges for separating content and carriage. These include the challenges for state DISCOMs due to lower tariffs, the sharing of legacy PPAs, difficulties with regulation, and the interplay with other reforms aimed at improving competition. Perhaps the central challenge here will be the balancing act of SERCs to ensure a level playing field that is essential for the cohesive functioning of existing DISCOMs and new entrants. The Mumbai parallel licensing example serves as a warning. Constant differences between competitors in Mumbai has led to endless litigation, leading to the inability of DISCOMs to optimise power

procurement plans or the tariff-setting process. Eventually, this led to a situation where customers pay a high price for electricity while DISCOMs also suffer losses due to the high cost of power.

Already the licensee model allows the private sector to participate in the electricity distribution sector with a proven track record of improving technical performance. If delicensing increases the possible perceived costs of entry for private players, there might be reduced interest to engage as distribution licensees. At the same time, if there are no takers for the parallel licensing model or if parallel licensing leads to outcomes similar to Mumbai, the net impact might turn out to be negative for the sector as a whole. Thus, the current amendment might need reconsideration.

Taking a cue from the international experience, two possible alternatives may be considered. The first is related to the legal separation of the carriage and content. In other countries, when retail competition has been implemented, the law has mandated that the companies engaged in the wires business cannot also be engaged in the content business. In most of these cases, the former state distribution companies have been converted completely to managers of the infrastructure, while the private sector has been allowed to compete freely in the content space. It would be worthwhile to consider a similar arrangement in India if a level playing field is to be created for the private sector.

Even if complete separation is not possible, the law must at least look to separate the roles of state DISCOMs into two different entities, taking a cue from similar examples in the deregulation of the aviation sector. Second, there could also be a case for the phased implementation of deregulation. In all likelihood, interest from the private sector to enter the distribution sector will be limited to certain geographies in urban areas, where the consumer mix consists mostly of high-end residential and C&I consumers. In these regions, the delicensing can be limited to certain consumer groups to avoid the issues of cherry picking, such as high-voltage C&I consumers with high rates of awareness and ability to pay. This can also serve as a test case for resolving other operational issues such as the sharing of legacy PPAs, streamlining the role of the regulator, and identifying a working model between the different DISCOMs. This can then be expanded to broader segments.

We also assessed the impact of distribution reform on green power adoption. Retail competition could theoretically spur green power adoption through a few avenues. First, it could lead to innovative green pricing mechanisms which could enhance consumer interest in adopting renewables. Second, private sector involvement could lead to increased agility to integrate renewables, particularly decentralised renewable energy, into the grid. Particularly through investments in cutting-edge technology to reduce costs and increase efficiencies. Third, it could lead to less financially encumbered DISCOMs which would increase payment security for generators. However, all these benefits are contingent on effective implementation of the delicensing model. If some of the operational issues highlighted earlier are not resolved, then the impact of retail competition on renewable adoption will be minimal.

Instead, the original electricity act and subsequent schemes have already provided strong instruments to encourage renewable energy adoption. For instance, renewable purchase obligations and open access provision. In particular, amending the open access rules could be an effective way to enable a larger choice set for consumers. This can be particularly useful for medium and large C&I consumers who would have the technical and financial wherewithal to adopt renewable energy from open access. This could be a more useful step than utilising an untested full retail competition model at this stage.

As the debate over the proposed Electricity (Amendment) Bill continues and it progresses towards parliamentary adoption, this study endeavours to offer an overview of the challenges associated with implementing content and carriage separation, fostering retail competition. It aims to provide guidance on addressing these challenges, drawing insights from existing literature, international experiences, and consultations with experts and stakeholders.

Endnotes

1 ORF Energy News Monitor, Volume XX, Issue 26, February 12, 2024, Observer Research Foundation, https://www.orfonline.org/research/energy-news-monitor-i-volume-xx-issue-26.

2 Central Electricity Authority, *All India Electricity Statistics: General Review 2022 (Containing Data for the Year 2020-21)*, 2022, https://cea.nic.in/wp-content/uploads/general/2022/GR_2022_FINAL.pdf.

3 Ministry of Power, Government of India, The Electricity Regulatory Commissions Act, 1998, https://cercind.gov.in/ElectReguCommiAct1998.pdf

4 Ajay Shankar and TCA Avni, *Resolving the Crisis in Power Distribution in India*, New Delhi: TERI, 2021, https://www.teriin.org/sites/default/files/2021-08/power-distribution-India-dp.pdf

5 Ministry of Power, Government of India, The Electricity Act, 2003, https://cercind.gov.in/Act-with-amendment.pdf

6 Central Electricity Authority, *All India Electricity Statistics: General Review 2022.*

7 Sabyasachi Majumdar, Girishkumar Kadam, and Vikram V, *Indian Power Sector – Electricity Distribution*, ICRA Limited, 2021, https://www.eqmagpro.com/wp-content/uploads/2021/03/ICRA-Power-Sector-Outlook-for-Power-Distribution-Segment-March-2021.pdf

8 Prayas Energy Group, *India Power Sector Reforms Update*, Prayas Energy Group, 2002, https://energy.prayaspune.org/images/pdf/india_reform_update_3_1.pdf

9 Prayas Energy Group, *Many Sparks but Little Light: The Rhetoric and Practise of Electricity Sector Reforms in India*, Prayas Energy Group, 2017, https://energy.prayaspune.org/images/pdf/Many_Sparks_but_Little_Light_for_web.pdf.

10 NITI Aayog, RMI, and RMI India, *Turning Around the Power Distribution Sector: Learning and Best Practices from Reforms*, NITI Aayog, 2021, https://www.niti.gov.in/sites/default/files/2021-08/Electricity-Distribution-Report_030821.pdf

11 "MSEDCL, Torrent to supply power to Bhiwandi," *The Economic Times,* December 2006, https://economictimes.indiatimes.com/industry/energy/power/msedcl-torrent-to-supply-power-to-bhiwandi/articleshow/879908.cms?from=mdr

12 Prayas Energy Group, *Review of the Distribution Franchisee model implemented by MSEDCL in the Bhiwandi circle*, Prayas Energy Group, 2009, https://energy.prayaspune.org/our-work/policy-regulatory-engagements/review-of-the-distribution-franchisee-model-implemented-by-msedcl-in-the-bhiwandi-circle.

13 NITI Aayog, RMI, and RMI India, *Turning Around the Power Distribution Sector: Learning and Best Practices from Reforms*,

14 Power Department, Government of NCT of Delhi, 2002, https://power.delhi.gov.in/power/about-us

15 Arjun Teotia, "Effects of Privatisation of Delhi Electricity Distribution under a Regulated Regime," *International Journal of Research in Humanities & Social Sciences* 2, no. 7 (2014), http://www.raijmr.com/ijrhs/wp-content/uploads/2017/11/IJRHS_2014_vol02_

issue_07_06.pdf.

16 Sheoli Pargal and Sudeshna Ghosh Banerjee, "More Power to India: The Challenge of Electricity Distribution," *Directions in Development, World Bank*, Washington DC, 2014 https://documents1.worldbank.org/curated/en/815021468042283537/pdf/More-power-to-India-the-challenge-of-electricity-distribution.pdf

17 Mrinal Madhav and Shivika Mehta, *Case of Reforms in the Indian Power Distribution Sector: A Move Towards Eradicating Energy Poverty*, 2010, https://www.osti.gov/etdeweb/servlets/purl/21390277.

18 Sheoli Pargal and Sudeshna Ghosh Banerjee, "More Power to India - The Challenge of Electricity Distribution"

19 NITI Aayog, RMI, and RMI India, *Turning Around the Power Distribution Sector*.

20 ICRA, Indian Power Sector – Electricity Distribution, ICRA, 2021, https://www.icra.in/

21 ICRA, Indian Power Sector – Electricity Distribution

22 Ministry of Power, *National Level AT&C Losses in Power Network down from 22.3% in 2020-21 to 16.4% in 2021-22*, August 2023, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1947709

23 Ministry of Power, Accelerated Power Develeopment & Reforms Programme (APDRP), n.d, https://mdoner.gov.in/contentimages/files/8_0.pdf

24 Ashwini K. Swain, "Political Economy of Distribution Reforms in Indian Electricity, *Centre for Policy Research*, 2016, https://www.semanticscholar.org/paper/Political-Economy-Of-Distribution-Reforms-In-Indian-Swain/c55f9adca1cd020e386fec64f009ffaefa4e4653

25 Ministry of Power, Government of India, Ujjwal Discom Assurance Yojana, n.d., https://www.uday.gov.in/home.php

26 Ministry of Power, Government of India, Scheme for Financial Restructuring of State Distribution Companies, October, 2012, https://powermin.gov.in/sites/default/files/uploads/Financial_restructuring_of_State_Distribution_Companies_discoms_Oct2012.pdf

27 Press Information Bureau, Government of India, "Union Power Ministry writes to States/UTs extending Rs 90,000 crore package under Atmanirbhar Bharat Abhiyan," Ministry of Power, May 2020, https://pib.gov.in/Pressreleaseshare.aspx?PRID=1624496

28 World Bank, "Electric power transmission and distribution losses (% of output)," last accessed December 19, 2023, https://data.worldbank.org/indicator/EG.ELC.LOSS.ZS?end=2014&start=1960&view=chart

29 Prateek Aggarwal and Karthik Ganesan, "Revisiting and Resolving Discoms' Legacy Issues," *Council on Energy, Environment and Water*, 2023, https://www.ceew.in/blogs/revisiting-and-resolving-discoms-legacy-issues.

30 Power Finance Corporation Limited, *Tenth Annual Integrated Rating and Ranking of Power Distribution Utilities*, Ministry of Power, 2022, https://pfcindia.com/DocumentRepository/ckfinder/files/GoI_Initiatives/Annual_Integrated_Ratings_of_State_DISCOMs/10th%20annual-integrated-ratings-and-ranking-2022%20(Aug%202022).pdf.

31 PFC, *Tenth Integrated Rating and Ranking*.

32 ICRA, Indian Power Sector – Electricity Distribution

33 Rahul Tongia and Rajasekhar Devaguptapu, "Breaking Down the Gap in DisCom Finances: Explaining the Causes of Missing Money," *Centre for Social and Economic Progress*, 2023, https://csep.org/impact-paper/breaking-down-the-gap-in-discom-finances-explaining-the-causes-of-missing-money/.

34 Business Today, "Electricity (Amendment) Bill, 2022 sent to standing committee on energy examination," *Business Today*, August 2022, https://www.businesstoday.in/latest/economy/story/electricity-amendment-bill-2022-sent-to-standing-committee-on-energy-examination-344040-2022-08-08

35 Mathew J. Morey and Laurence D. Kirsch, "Retail choice in electricity: what have we learned in 20 years?" *Electric Markets Research Foundation*, 2016 https://hepg.hks.harvard.edu/files/hepg/files/retail_choice_in_electricity_for_emrf_final.pdf.

36 Ali Hortascu et al., "Power to Choose? An Analysis of Consumer Inertia in the Residential Electricity Market," *American Economic Journal: Economic Policy* 9, no 5 (2017), https://www.aeaweb.org/articles?id=10.1257/pol.20150235

37 European Union Agency for Cooperation of Energy Regulators, *ACER-CEER Retail and Consumer Protection Volume MMR*, Council of European Regulators, 2021, https://extranet.acer.europa.eu/events/acer-ceer-webinar-on-the-energy-retail-and-consumer-protection-market-monitoring-report/documents/211109_energy%20retail%20%20consumer%20protection%20mmr_webinarv1.1_final.pdf

38 U.S. Energy Information Administration ,"*Form EIA-861 Annual Industry Report Instructions,*" last accessed December 20, 2023, https://elecidc12c.eia.doe.gov/2017%20EIA-861%20Instructions.pdf.

39 Reserve Bank of India, "*Bulletin*", Reserve Bank of India Bulletin LXXVI, no. 6 (2022), https://rbidocs.rbi.org.in/rdocs/Bulletin/PDFs/RBIJUNEBULLETIN2022BC3DC495560D430E9D6E7A0122FF225E.PDF.

40 Reserve Bank of India, *Report on Trend and Progress of Banking in India 2022-23*, (New Delhi: Reserve Bank of India, 2023), https://rbi.org.in/Scripts/AnnualPublications.aspx?head=Trend%20and%20Progress%20of%20Banking%20in%20India.

41 Prabhat Barnwal and Nicholas Ryan, "Is electrification in India fiscally sustainable?" *Ideas for India*, July 11, 2023, https://www.ideasforindia.in/topics/governance/is-electrification-in-india-fiscally-sustainable.html.

42 Carlos Lapuerta, Boaz Moselle, "Network Industries, Third Party Access and Competition Law in the European Union" Volume 19, Issue 3, (Spring 1999), https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1497&context=njilb&httpsredir=1

43 Ministry of Power, Government of India, "Electricity Act 2003" https://powermin.gov.in/sites/default/files/uploads/The Electricity Act_2003.pdf

44 Ministry of Power, Government of India, "Electricity Act 2003"

45 Supreme Court of India, "Tata Power Company Ltd vs Reliance Energy Limited & Ors" (6 May 2009), https://indiankanoon.org/doc/1827056/

46 Supreme Court of India, Tata Power Company Ltd vs Reliance Energy Limited & Ors

47 Sanjay Jog, "Tatas get Mumbai power distribution licence for 25 years," *Business Standard*, (16 August 2014), https://www.business-standard.com/article/pti-stories/

merc-grants-25-yr-power-distribution-licence-to-tata-power-11 40815 00220_1.html

48 Tata Power, Overview, https://www.tatapower.com/know-us/overview.aspx

49 Conversation with former CMD, Tata Power DDL

50 Conversation with former CMD, Tata Power DDL

51 Prayas (Energy Group), *In the Name of Competition: The annals of 'Cost-plus Competition' in the Electricity sector in Mumbai,*, Prayas Energy Group, February 2017, https://energy.prayaspune.org/images/pdf/in_the_name_of_competition.pdf

52 Conversation with former CMD, Tata Power DDL

53 Press Trust of India, "Migration from Reliance Infra to TPC will reduce monthly bills: MERC," *Economic Times*, (7 September 2012), https://economictimes.indiatimes.com/industry/energy/power/migration-from-reliance-infra-to-tpc-will-reduce-monthly-bills-merc/articleshow/16287442.cms?from=mdr

54 Press Trust of India, "MERC puts 300 units cap for Switchover from RInfra to Tata Power," Moneylife, https://www.moneylife.in/article/merc-puts-300-units-cap-for-switchover-from-rinfra-to-tata-power/28023.html

55 Appellate Tribunal for Electricity, "Appeal no 246 & 229 (2012)," (28 November 2014), https://new.merc.gov.in/wp-content/uploads/2022/07/ATE-Judgment-dated-28.11.2014.pdf

56 Conversation with former CMD, Tata Power DDL

57 Power Finance Corporation (PFC*), 12th Annual Integrated Rating and Ranking of Power Distribution Utilities,* March 2024, https://pfcindia.com/ensite/DocumentRepository/ckfinder/files/GoI_Initiatives/Annual_Integrated_Ratings_of_State_DISCOMs/12%20Annual%20Integrated%20Report_Print%20version-compressed2.pdf

58 Power Finance Corporation (PFC), "*12th Annual Integrated Rating and Ranking of Power Distribution Utilities*"

59 Press Trust of India, "AEML to Source 30% Power From RE By 2023, Customers can opt by Paying More," *Financial Express*, April 7, 2021, https://www.financialexpress.com/business/industry-aeml-to-source-30-power-from-re-by-2023-customers-can-opt-by-paying-more-2228692/

60 Prafulla Marpakwar, "Private players seek entry in Maharashtra Electricity Distribution Company Limited areas," *Times of India,* January 2023, http://timesofindia.indiatimes.com/articleshow/96824689.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

61 Central Electricity Authority, *All India Electricity Statistics: General Review 2022*

62 Power Finance Corporation (PFC), *12th Annual Integrated Rating and Ranking of Power Distribution Utilities*

63 National Academies of Sciences, Engineering, and Medicine, *The Future of Electric Power in the United States*, The National Academies Press,n.d, https://www.nationalacademies.org/our-work/the-future-of-electric-power-in-the-us#:~:text=Electricity%20is%20fundamental%20to%20nearly,lives%20for%20decades%20to%20come.

64 Paulina Beato & Carmen Fuente, "Retail Competition in Inter-American Development Bank, Washington, D.C., March 1999, https://publications.iadb.org/publications/english/document/Retail-Competition-in-Electricity.pdf

65 Press Information Bureau, "India Takes Another Big Step Towards Achieving 500 GW of Non-Fossil Fuel-Based Electricity Installed Capacity by 2030," December 2022, https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1881484

66 Press Information Bureau, "Electricity Amendment Bill, 2014 Introduced in Lok Sabha; Changes Aimed at Promoting Competition, Efficiency in Operations and Improvement in Quality of Supply of Electricity," December 2014, https://www.pib.gov.in/newsite/PrintRelease.aspx?relid=113779

67 JMK Research, *Green Energy Tariff: Purchasing Electricity With Green Attributes From DISCOMs,* September 2022, https://jmkresearch.com/green-energy-tariff-purchasing-electricity-with-green-attributes-from-discoms/

68 Srinwanti Das, "Green Power Tariff: An Attractive Option for Consumers to Access Solar and Wind Power," *Mercom Research Focus*, 2021, https://www.mercomindia.com/green-power-tariff-solar-wind

69 Srinwanti Das, "Green Power Tariff: An Attractive Option for Consumers to Access Solar and Wind Power"

70 Press Information Bureau, "Ministry of Power notifies 'Green Energy Open Access' Rules to Accelerate Ambitious Renewable Energy Programmes," July 2022, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1842737

71 Arjun Joshi, "Consumers with Aggregate Demand of 100 kW Can Avail Green Energy Open Access," *Mercom India,* May 2023), https://www.mercomindia.com/100-kw-avail-green-energy-open-access

72 Press Information Bureau, Ministry of Power notifies "Green Energy Open Access Rules to Accelerate Ambitious Renewable Energy Programmes," July 2022, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1842737

73 Rachita Prasad, "Tata Power Consumers can soon opt For 100% Green Energy Supply in Maharashtra," *Economic Times,* March 2021, https://economictimes.indiatimes.com/industry/renewables/soon-tata-power-to-offer-100-green-energy-in-maharashtra/articleshow/81713363.cms

74 Tata Power, "Tata Power Lights up 27,000 Homes with Green Power in Mumbai," 2023, https://www.tatapower.com/media/PressReleaseDetails/2075%20/tata-powerlights-up-27000-homes-with-green-power-in-mumbai-resulting-in-270-mus-of-green-power-%20consumption-equivalent-to-offsetting-200-kiloton

75 Tata Power, "Tata Power Lights up 27,000 Homes with Green Power in Mumbai"

76 Anuja Jha, On Diwali, "Adani Electricity Powered Mumbai with 100% Clean Energy for 4 hours," *India Today*, November 2023, https://www.indiatoday.in/business/story/on-diwali-adani-electricity-powered-mumbai-with-100-clean-energy-for-4-hours-2464336-2023-11 -17

77 Swantje Sundt & Katrin Rehdanz, "Consumers' Willingness to Pay For Green Electricity: A Meta-Analysis of the Literature," *Energy Economics*, Volume 51, Pages 1-8, (2015), https://www.sciencedirect.com/science/article/pii/S0140988315001784

78 Lauren Knapp, Eric O'Shaughnessy, Jenny Heeter, Sarah Mills, John M. DeCicco, "Will Consumers Really Pay for Green Electricity? Comparing Stated and Revealed Preferences for Residential Programs in The United States," *Energy Research & Social Science*, Volume 65, (2020), https://www.sciencedirect.com/science/article/pii/S2214629620300347

79 Ministry of Power, Government of India, "Electricity Act 2003" https://powermin.gov.in/sites/default/files/uploads/The Electricity Act_2003.pdf

80 Ministry of Power, Government of India, "Electricity Act 2003"

81 Central Electricity Authority, *Renewable Energy Report, Monthly Reports 2022-23*, https://cea.nic.in/renewable-generation-report/?lang=en

82 Central Electricity Authority, *Renewable Energy Report, Monthly Reports 2022-23*

83 Grid-India (POSOCO), *Monthly Operational Performance Reports 2022-23,* https://posoco.in/en/download/monthly_report_may_2022/

84 Grid-India (POSOCO), *Monthly Operational Performance Reports 2022-23*

85 Manish Kumar & Manish Mishra, "Electricity Transition in India's Renewable-Rich States Needs to Accelerate, says Study," *Mongabay*, March 2023, https://india.mongabay.com/2023/03/electricity-transition-in-indias-renewable-rich-states-needs-to-accelerate-says-study/

86 Central Electricity Authority, "*Renewable Energy Report," Monthly Reports 2022-23,* https://cea.nic.in/renewable-generation-report/?lang=en

87 Venugopal Mothkoor, Anjali Jain & Rajnath Ram, "Renewable Energy Resource Adequacy Planning to Meet RPO By the States in India," *NITI Aayog*, Government of India , February 2024, https://www.niti.gov.in/sites/default/files/-02/Policy%20Paper_Energy_RPO_1.pdf

88 West Bengal Electricity Regulatory Commission, "Tariff Policy 2016," https://www.wberc.gov.in/sites/default/files/tariff-policy-28.01.2016.pdf

89 Rishi Ranjan Kala, "Govt fixes RPO target at 24.61 per cent for FY23," *The Hindu, Business Line*, July 2022, https://www.thehindubusinessline.com/companies/govt-fixes-rpo-target-at-2461-per-cent-for-fy23/article65671834.ece

90 Grid-India, Renewable Energy Certificate Registry of India, https://www.recregistryindia.nic.in/

91 Sarthak Takyar, "Missed Targets: Low RPO compliance calls for a Policy Relook," *Indian Infrastructure,* March 2024, https://indianinfrastructure.com/2024/03/15 / missed-targets-low-rpo-compliance-calls-for-a-policy-relook/

92 Grid-India, *Renewable Energy Certificate Registry of India*, https://www.recregistryindia.nic.in/

93 K. C. Saini, S. Verma, G. M. S. Chandra, K. Usman, H. Kundra and M. Agarwal, "Renewable Energy Certificate (REC) Mechanism as an enabler of Renewable energy penetration in India: Looking back and way forward," *22nd National Power Systems Conference (NPSC)*, New Delhi (2022), https://ieeexplore.ieee.org/document/10069829

94 Aparna Sawhney, "Renewable Energy Certificates Trading in India: A Decade in Review," ADBI Working Paper 1313 *Asian Development Bank Institute*, 2022, https://www.adb.org/publications/renewable-energy-certificates-trading-in-india-a-decade-inreview

95 Power Exchange India Limited (PXIL), "Suggestions and observation on Draft CERC (Terms and Conditions for Renewable Energy Certificates for Renewable Energy

Generation) Regulations," (24 March 2022), https://cercind.gov.in/2022/draft_reg/comments_REC/10.%20PXIL_comments_draftRECregulation2022.pdf

96 Aparna Sawhney, "Renewable Energy Certificates Trading in India: A Decade in Review," ADBI Working Paper 1313 , *Asian Development Bank Institute*, 2022, https://www.adb.org/publications/renewable-energy-certificates-trading-in-india-a-decade-inreview

97 Ankita Chauhan, "India Promotes Renewable Procurement Through Open Access," *S & P Global, Commodity Insights*, September 21, 2021, https://www.spglobal.com/commodityinsights/en/ci/research-analysis/india-promotes-renewable-procurement-through-open-access.html

98 Prayaspune, "Comments and Suggestions on draft APERC Renewable Power Purchase Obligation (Compliance by Purchase of Renewable Energy/ Renewable Energy Certificates) Regulation," (2022), https://energy.prayaspune.org/images/pdf/prayas_comments_on_aperc_rppo_regs_2022._435757454.pdf

99 Ministry of New & Renewable Energy, Government of India, "Corrigendum to Renewable Purchase Obligation (RPO) and Energy Storage Obligation Trajectory till 2029-30" (22 July 2022), https://mnre.gov.in/centre-rules/

100 Maharashtra Electricity Regulatory Commission, "Explanatory Memorandum on Draft Maharashtra Electricity Regulatory Commission (Renewable Purchase Obligation, its Compliance and Implementation of Renewable Energy Certificate Framework) Regulations 2019," (October 2019), https://merc.gov.in/wp-content/uploads/2022/07/EM-for-Draft-MERC-RPO-REC-Regulations-2019.pdf

101 Maharashtra Electricity Regulatory Commission, "Explanatory Memorandum on Draft Maharashtra Electricity Regulatory Commission (Renewable Purchase Obligation, its Compliance and Implementation of Renewable Energy Certificate Framework) Regulations 2019"

102 Grid-India, "Procedure for Implementation of REC Mechanism in Compliance of Central Electricity Regulatory Commission (Terms & Conditions for Renewable Energy Certificates for Renewable Energy Generation) Regulations," (2022), https://www.recregistryindia.nic.in/pdf/Procedure_REC/detailed_Procedures_for_implementation_of_REC_Mechanism_in_compliance_of_CERC_REC_Regulation_2022.pdf

103 Press Information Bureau, Ministry of Power Formulates Several Steps to Deepen the Market for Green Electricity and to Provide Competitive Price Signals," (9 February 2023), https://pib.gov.in/PressReleasePage.aspx?PRID=1897770

104 Ministry of Power, Government of India, "Electricity Act 2003" https://powermin.gov.in/sites/default/files/uploads/The Electricity Act_2003.pdf

105 G Balachandar, "Tamil Nadu pips Karnataka as the Leader in overall Renewable Capacity," *The Hindu Business Line*, February 2022, https://www.thehindubusinessline.com/news/tamil-nadu-pips-karnataka-as-the-leader-in-overall-renewable-capacity/article65084204.ece

106 Jyoti Gulia, Akhil Thayillam, Prabhakar Sharma & Vibhuti Garg, "India's Renewable Energy Open Access Market: Trends and Outlook," *Institute of Energy Economics & Financial Analysis*, August 2022, https://ieefa.org/sites/default/files/2022-08/India%E2%80%99s%20Renewable%20Energy%20Open%20Access%20Market.pdf

107 Ministry of Power, Government of India, "Electricity Act 2003" https://powermin.gov.in/sites/default/files/uploads/The Electricity Act_2003.pdf

108 Jyoti Gulia, Akhil Thayillam, Prabhakar Sharma & Vibhuti Garg, "India's Renewable Energy Open Access Market: Trends and Outlook"

109 Ministry of Power, "National Tariff Policy" (2006), https://cea.nic.in/wp-content/uploads/legal_affairs/2020/09/Tariff%20policy.pdf

110 Central Electricity Authority, "*Renewable Energy Report," Monthly Reports 2022-23,* https://cea.nic.in/renewable-generation-report/?lang=en

111 The Karnataka Electricity Regulatory Commission, "Terms and Conditions for Green Energy Open Access) Regulations," 2022, https://kerc.karnataka.gov.in/

112 Karnataka Electricity Regulatory Commission, Terms and Conditions for Green Energy Open Access) Regulations"

113 Prayas (Energy Group), "Estimating Impact of Renewable Energy Wheeling and Banking Arrangement on Karnataka ESCOMs," *Prayas Energy Group,* 2022, https://kerc.karnataka.gov.in/uploads/95551659758749.pdf

114 Prayas (Energy Group), "Estimating Impact of Renewable Energy Wheeling and Banking Arrangement on Karnataka ESCOMs"

115 Forum Of Regulators (FoR), *"Report on Developing Model Regulations on Methodology for Calculation of Open Access, Charges and Banking Charges for Green Energy Open Access Consumers,"* 2022, https://forumofregulators.gov.in/Data/study/Final%20Report%20of%20FOR-GEOA.pdf

116 News Bureau, "Shrinking RE Receivables," *Energetica,* January 2023, https://www.energetica-india.net/articles/shrinking-re-receivables

117 CRISIL, "Receivables of leading RE companies to shrink 20% this fiscal," *CRISIL,* September 2022, https://www.crisil.com/content/dam/crisil/mailers/rating-newsletter/2022/september/receivables-of-leading.pdf

118 Press Information Bureau, "Power Ministry Working on A Scheme to Liquidate the Past Dues of Discoms," May 2022, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1828243

119 Power Finance Corporation (PFC), "12th Annual Integrated Rating and Ranking of Power Distribution Utilities,"

120 Power Finance Corporation (PFC), "12th Annual Integrated Rating and Ranking of Power Distribution Utilities,"

121 Ministry of Power, Government of India, "Notification on Electricity (Late Payment Surcharge) Rules 2021," February 2022, https://powermin.gov.in/sites/default/files/LPS_rules_Notification_dated_22_2_2021.pdf

122 Ministry of Power, Government of India, "Notification on Electricity (Late Payment Surcharge) Rules 2021,"

123 CRISIL, "Receivables of leading RE companies to shrink 20% this fiscal," *CRISIL, S*eptember 2022, https://www.crisil.com/content/dam/crisil/mailers/rating-newsletter/2022/september/receivables-of-leading.pdf

124 Shaurya, "Payment Security Mechanism for Solar Projects under VGF Program Gets ₹5 Billion Fund," *Mercom India,* February 2019, https://www.mercomindia.com/payment-security-solar-vgf-5-bn-fund

125 Sarah Ladislaw and Sharmila Bellur, "Payment Security Mechanism for Solar Power in India: Can India Secure its Future and the Future of Solar Developers as well,"

Centre for Strategic & International Studies (CSIS), 2017, https://www.csis.org/analysis/payment-security-mechanism-solar-power-india-can-india-secure-its-future-and-future-solar#:~:text=The%20Payment%20Security%20Fund%20is,of%20power--%2C%20and%20cover%20other

126 Rewa Ultra Mega Solar Limited, https://rumsl.mp.gov.in/solar-project/

127 Saumy Prateek, "The Four-Tier REWA Payment Security Model Responsible for Low Bids," *Mercom India,* October 2017, https://www.mercomindia.com/four-tier-rewa-payment-security-model-responsible-low-bids

128 Central Electricity Authority, "Draft Guidelines for Resource Adequacy Planning Framework for India," September 2022, https://cea.nic.in/wp-content/uploads/irp/2022/09/Draft_RA_Guidelines___23_09_2022_final.pdf

129 Central Electricity Authority, "Draft Guidelines for Resource Adequacy Planning Framework for India,"

130 Central Electricity Authority, "Draft Guidelines for Resource Adequacy Planning Framework for India,"

131 Forum Of Regulators (FoR), "Report on Developing Model Regulations on Methodology for Calculation of Open Access, Charges and Banking Charges for Green Energy Open Access Consumers," September 2022, https://forumofregulators.gov.in/Data/study/Final%20Report%20of%20FOR-GEOA.pdf

132 Venugopal Mothkoor, Anjali Jain & Rajnath Ram, "Renewable Energy Resource Adequacy Planning to Meet RPO By the States in India," *NITI Aayog*, Government of India, 2024, https://www.niti.gov.in/sites/default/files/2024-02/Policy%20Paper_Energy_RPO_1.pdf

133 Venugopal Mothkoor, Anjali Jain & Rajnath Ram, "Renewable Energy Resource Adequacy Planning to Meet RPO By the States in India"

134 Venugopal Mothkoor, Anjali Jain & Rajnath Ram, "Renewable Energy Resource Adequacy Planning to Meet RPO By the States in India"

135 Venugopal Mothkoor, Anjali Jain & Rajnath Ram, "Renewable Energy Resource Adequacy Planning to Meet RPO By the States in India"

136 Press Information Bureau, "Nearly 70.1 GW Solar Power Capacity Installed in the Country: Union Minister for New & Renewable Energy and Power," August 2023, https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1947140

137 Sakshi Dhakre, "PM chairs a meeting to launch "Pradhanmantri Suryodaya Yojana" With the Target of Installing Rooftop Solar on 1 Crore Houses," *Insider by Finology,* January 2024, https://insider.finology.in/finance/pradhan-mantri-suryodaya-yojana

138 Press Information Bureau, "Roof Top Solar Capacity installations growing at Compound annual growth rate of around 46%: Union Power and New & Renewable Energy Minister," December 2023, https://pib.gov.in/PressReleasePage.aspx?PRID=1989806

139 Ministry of New and Renewable Energy, Government of India, Programme/Scheme wise Cumulative Physical Progress, 2024, https://mnre.gov.in/physical-progress/

140 Pablo del Río & Pere Mir-Artigues, "A Cautionary Tale: Spain's solar PV investment

bubble," *IISD,* February 2014, https://www.iisd.org/gsi/sites/default/files/rens_ct_spain.pdf

141 Pablo del Río & Pere Mir-Artigues, "A Cautionary Tale: Spain's solar PV Investment Bubble

142 Yihsu Chen, Makoto Tanaka, Ryuta Takashima, "Death spiral, Transmission Charges, and Prosumers in the Electricity Market," *Applied Energy*, Volume 332 (2023), https://www.sciencedirect.com/science/article/pii/S0306261922017457)

143 Yola Riana Effendi, "Policy and Economic Impacts of End Users Tariff Policies Considering the "Death Spiral": Application to A Spanish Case Study," *Universidad Pontificia Comillas,* June 2017, https://repositorio.comillas.edu/jspui/bitstream/11531/24586/1/TFM000832.pdf

144 Yingang Zhang, David Parker & Colin Kirkpatrick, "Competition, Regulation and Privatisation of Electricity Generation in Developing Countries: Does the Sequencing of the Reforms Matter?" Centre on Regulation and Competition (CRC) Working papers 30599, University of Manchester, *Institute for Development Policy and Management (IDPM)*, 2004, https://ideas.repec.org/p/ags/idpmcr/30599.html

145 Joseph E Stiglitz, *Globalization and Its Discontents*. W. W. Norton & Company, 2003

146 Yingang Zhang, David Parker & Colin Kirkpatrick, "Competition, Regulation and Privatisation of Electricity Generation in Developing Countries: Does the Sequencing of the Reforms Matter?"

147 Yingang Zhang, David Parker & Colin Kirkpatrick, "Competition, Regulation and Privatisation of Electricity Generation in Developing Countries: Does the Sequencing of the Reforms Matter?"

About the Authors

Promit Mookherjee *is Associate Fellow at ORF's Centre for Economy and Growth.*

Mihir Swarup Sharma *is the Director of ORF's Centre for Economy and Growth.*

Lydia Powell *is Distinguished Fellow at ORF.*

Ideas . Forums . Leadership . Impact

20, Rouse Avenue Institutional Area,
New Delhi - 110 002, INDIA
Ph. : +91-11-35332000. **Fax :** +91-11-35332005
E-mail: contactus@orfonline.org
Website: www.orfonline.org