BSES Rajdhani Power Limited

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RMI

Unlocking a Distributed Energy Marketplace in India

How peer-to-peer energy trading can power a clean, digital grid

Report / June 2026

Rocky Mountain Institute (RMI) is an independent, nonpartisan nonprofit founded in 1982 that transforms global energy systems through market-driven solutions to secure a prosperous, resilient, clean energy future for all. In collaboration with businesses, policymakers, funders, communities, and other partners, RMI drives investment to scale clean energy solutions, reduce energy waste, and boost access to affordable clean energy in ways that enhance security, strengthen the economy, and improve people's livelihoods. RMI is active in over 50 countries.

All India Discoms Association (AIDA) is a not-for-profit collaboration platform representing a wide spectrum of electricity distribution entities of India. Its members are state government owned Distribution Companies, private sector Discoms, Electricity Departments of Union Territories and Franchisees.

AIDA serves as the unified voice of all electricity distribution entities in the country serving 345 million electricity consumers. Its core objectives include fostering collaboration among members, advocating for progressive policy and regulatory reforms, and driving holistic development across the power distribution sector.

BSES Rajdhani Power Limited (BRPL) is a joint venture between Reliance Infrastructure and the Government of the National Capital Territory (NCT) of Delhi. It is one of four electricity distribution companies in Delhi, supplying power across an area of ~700 sq. km. to over 30 lakh consumers in south and west Delhi. In FY 2024-25, BRPL met a peak demand of 3,809 MW and operated over 25,000 circuit km of low-tension and high-voltage power lines. BRPL's core values include striving for operational excellence, customer satisfaction, prioritising safety, and building a highly engaged workforce.

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Acknowledgements

We extend our sincere gratitude to Shri Alok Kumar, Director General, and Shri Satyendra Nath Kalita, Director of Regulatory Affairs, All India Discoms Association (AIDA) for their guidance and collaboration in developing this white paper. Their insights and expertise were instrumental to the research and analysis presented in this publication.

Table of Contents

Table of Figures

Foreword

AIDA is pleased to present this white paper, 'Unlocking a Distributed Energy Marketplace in India' in collaboration with RMI and BSES Rajdhani. The paper explores peer-to-peer energy trading, a novel model for rooftop solar adoption, that can help the country's distribution companies transition from simple energy sellers to orchestrators of a complex, bidirectional, and decentralised distribution network.

Distribution companies are facing new challenges as the accelerating adoption of rooftop solar and other behind-the-meter resources alter power flows on their networks. Distributed solar exports are growing even as granular visibility into their location, capacity, and volume of exports remains limited. Peer-to-peer (P2P) energy trading, in which consumers purchase electricity directly from rooftop solar owners via digital platforms, addresses this gap by improving visibility, measurement, and planning. Anchored in the national-level digitalisation efforts under the India Energy Stack, P2P can be the foundational use case for a broader distributed energy marketplace — one in which system-level services from distributed storage and flexible loads are traded seamlessly and transparently.

The analysis outlined in this white paper provides an objective view of the fiscal and non-fiscal implications of P2P across rooftop solar owners (prosumers), consumers, and distribution companies. It envisions a four-stage evolution pathway from traditional net energy metering to an advanced digital distributed energy marketplace. Finally, the paper identifies the critical regulatory, technical, and market enablers required to realise the full value of P2P.

We, at AIDA, believe that P2P can catalyse India's digital energy revolution, and hope that distribution companies find value in its proposition. We remain committed to working with all stakeholders and provide support wherever necessary.

Alok Kumar
Director General, All India Discoms Association (AIDA)

Executive Summary

India's electricity distribution sector is changing quickly as distributed energy resources — rooftop solar, battery energy storage systems, electric vehicle charging, and flexible loads — now sit behind the meter and affect power flow on distribution networks. Within this evolving landscape, distribution companies will require mechanisms that can integrate these resources into grid operations in a controlled manner that generates value for all. Peer-to-peer (P2P) energy trading, in which electricity consumers buy energy directly from prosumers at mutually agreed prices on digital platforms,[i] is one such mechanism that can help distribution companies transform from passive energy sellers into active coordinators of a more flexible and participatory distribution system. Crucially, P2P can catalyse the emergence of a broader distributed energy marketplace, in which third-party entities such as aggregators can bundle distributed resources to provide system services, such as demand response and distributed storage.

India's policy and institutional ecosystem is already moving in this direction. The India Energy Stack and P2P initiative by the Ministry of Power signals a shift towards interoperable, digital infrastructure for the energy system. P2P can serve as an anchor use case within this context by operationalising DER participation and unlocking new system-level value.

For prosumers, P2P offers a clearer value proposition than net energy metering (NEM) alone.[ii] It can enable surplus rooftop solar (RTS) to earn an explicit market-linked price that can be higher than net metering benchmarks, thus enhancing returns on RTS installations and generating a direct income stream.

For commercial and industrial (C&I) consumers, P2P provides access to competitively priced, locally generated green energy that can be cheaper than marginal grid supply and more cost-effective than certificate-based

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[i] Prosumers are consumers with RTS installations that can export solar energy to the grid through a net energy meter.

[ii] Net energy metering is a billing mechanism that allows a consumer with an RTS installation to offset electricity imported from the grid with electricity exported to the grid. Under current regulations in Delhi, a consumer with RTS can offset consumption — including during peak periods — with exports from RTS.

procurement. P2P introduces flexibility in procurement, allowing consumers to match purchases with real-time demand, avoid long-term commitments, and benefit from a simpler onboarding process.

For distribution companies (DISCOMs), while P2P introduces some revenue considerations, it offers a more balanced alternative to traditional models such as NEM and green energy open access.[iii] Unlike NEM, P2P confines surplus energy transactions to solar hours, preserving peak-period billing and mitigating revenue erosion. Compared to C&I migration to open access or self-generation, P2P mitigates higher revenue risks while offering new avenues for cost recovery through transaction charges. Crucially, P2P improves network visibility by requiring time block–level data on generation, consumption, and transactions. This information helps DISCOMs forecast demand more accurately and plan procurement with fewer surprises. Finally, it can accelerate RTS adoption, helping DISCOMs meet their renewable consumption obligations.

However, realising the benefits of P2P will require coordinated action across regulatory and technical dimensions. With thoughtful design, P2P can become a cornerstone of India’s transition to a modern, digital, and decentralised power system.

[iii] Green energy open access is a regulatory framework that enables eligible electricity consumers to procure renewable energy directly from a generator or trader, or through power exchanges, using the transmission and distribution network of DISCOMs, upon payment of applicable network and regulatory charges.

How India’s Power Sector Can Benefit from P2P

India’s electricity sector, characterised by centralised generation and long-term power purchase agreements (PPA), stands at a critical juncture — rapid peak load growth driven by cooling demand and rising renewable energy penetration is driving demand and supply-side volatility, forcing distribution companies (DISCOMs) to consider innovative grid flexibility solutions. Within this context, peer-to-peer (P2P), in which electricity consumers buy energy directly from prosumers at mutually agreed prices on digital platforms, energy trading offers several opportunities that can transform India’s decentralised energy landscape (see **Exhibit 1 on the following page**).

1. **Drives domestic adoption of rooftop solar** by monetising surplus generation on the P2P network to unlock transparent and immediate income generation.

2. **Provides commercial and industrial consumers and large domestic consumers with access to low-cost, local green energy** that can be procured independent of long-term open access contracts. This offers them flexibility to purchase green power when they most need it and presents a compelling alternative to PPA-based Green Energy Open Access (GEOA) contracts. P2P also offers a pathway for large domestic consumers with limited or no roof access to procure green energy and switch to a lower tariff slab.

3. **Unpacks DISCOM benefits,** including enhancing network visibility and planning, mitigating traditional net energy metering (NEM)–linked revenue losses, lowering distribution losses, and contributing towards renewable consumption targets.

4. **Unlocks a distributed energy marketplace** that can catalyse an ecosystem of new market players such as aggregators that provide services beyond P2P, including demand flexibility, distributed battery storage, and virtual power plants.

Exhibit 1: Opportunities Created by P2P Energy Trading

In the following sections, we take a deeper dive into P2P energy trading and how it can provide value for all stakeholders. We also identify the key enablers that can lower barriers to entry and help implement P2P at scale.

What Is Peer-to-Peer Energy Trading?

Peer-to-peer energy trading is a market arrangement in which electricity consumers buy energy directly from prosumers at mutually agreed prices using a digital platform. Distributed energy resources such as rooftop solar and batteries already inject energy into the distribution grid, whereas P2P adds a commercial layer. The added commercial layer allows this energy to be transacted explicitly between participants instead of being absorbed implicitly through net metering or feed-in tariffs. Current regulations permit the sale of surplus renewable energy generation, including electricity exported from batteries charged using renewable sources.

P2P does not create a new physical flow of electricity. Power continues to flow through the existing distribution network, governed by technical constraints and operating limits. What changes is the allocation of commercial rights and obligations associated with that energy. To function safely and at scale, P2P requires a clear separation of roles between market actors and system operators.

Key Roles and Stakeholders in the P2P Ecosystem

The key roles in the P2P ecosystem include:

1. **Prosumers:** Consumers that also produce energy through distributed energy resources (DERs) such as rooftop solar (RTS) or via stored electricity in batteries, and that can actively choose when and how to use, store, and monetise that energy. In P2P energy trading, a prosumer can sell excess energy directly to consumers within the respective DISCOM's network.

2. **Consumers:** Consumers registered with the respective DISCOM's network who want to purchase renewable energy from prosumers through P2P. State regulations determine which consumers can participate in P2P. For example, Delhi allows any consumer class with a sanctioned load of less than 200 kVA, whereas Karnataka permits only domestic consumers.

3. **P2P services:** Essential P2P transaction services delivered by empanelled third-party entities. These services include developing, maintaining, and operating the digital transaction platform, aggregating and orchestrating individual DERs **(Exhibit 2)**, and providing measurement and verification (M&V), reconciliation, and trust layers.

4. **Grid services:** Essential services required for the safe and reliable operation of large-scale distributed generation in the grid. These services include:
   a. Market operation: Ensuring sound operation of the P2P energy marketplace, including enforcing technical limits, eligibility requirements, bidding procedures, and settlement and grievance redressal rules.
   b. Enabling regulations: Creating a conducive regulatory environment that lowers the entry barriers for developing a distributed energy ecosystem. Regulations can include clear definitions of market actors and services; standardised and replicable guidelines for scheduling, bidding, settlement, M&V, etc.; and a legal framework for implementing sandboxes to test new market products and services.
   c. Distribution system orchestration: Planning, operating, and maintaining the distribution network, including scheduling power, ensuring secure power flows, and managing outages. In time, distribution system orchestrator (DSO) service providers would be needed that can manage a distributed energy marketplace to provide applications like demand flexibility and P2P trading. These applications would rely on digital platforms for forecasting, scheduling, and settlement of distributed energy services that

coordinate with aggregators and service providers to optimise the network and drive DER adoption.

Aggregators are third-party entities that aggregate individual prosumers or consumers and coordinate and manage trades of multiple DERs such as RTS, EVs, smart appliances, and battery storage.

Aggregators may offer bundled value-added services, including annual maintenance contracts (AMC) for optimum RTS performance, home energy reports, discounted energy-efficient appliances, and EV charging plans. Further, they may provide services such as customer onboarding, asset registry, solar forecasting, trade optimisation, and settlement, thus lowering operational complexity for DISCOMs implementing P2P at scale. Collectively, these benefits empower prosumers and consumers with attractive economics, more transparency, and higher engagement.

Exhibit 2: Need for Aggregators for Scaling P2P Energy Trading

Price Discovery Potential in P2P Energy Trading

P2P energy trading is built on the premise that it can simultaneously deliver better returns for prosumers and bill savings for high-tariff consumers such as commercial and industrial (C&I) customers. Given the cross-subsidy regime, P2P energy trading can flourish in India as the tariff gap between domestic and C&I consumers offers a wide price discovery window for prosumers and consumers. As a result, the mutually agreed price between the prosumer and the consumer will typically settle within a band that is more attractive to prosumers than net metering, yet lower than the applicable C&I tariff.

For example, in Delhi, where domestic tariffs range from ₹3 to ₹8/kWh and C&I tariffs range from ₹6 to ₹8.5/kWh, P2P trades are most likely to occur between residential prosumers and C&I consumers at a market-clearing price of approximately ₹5 to ₹7/kWh (see **Exhibit 3)**. For EV charging, consumers unlock the option of green charging but pay a slight premium.

P2P, however, is closely tied to the cross-subsidy structure. Given that policy direction increasingly emphasises cross-subsidy rationalisation, as highlighted in the Draft National Electricity Policy 2026, the arbitrage window underpinning P2P price discovery may narrow.

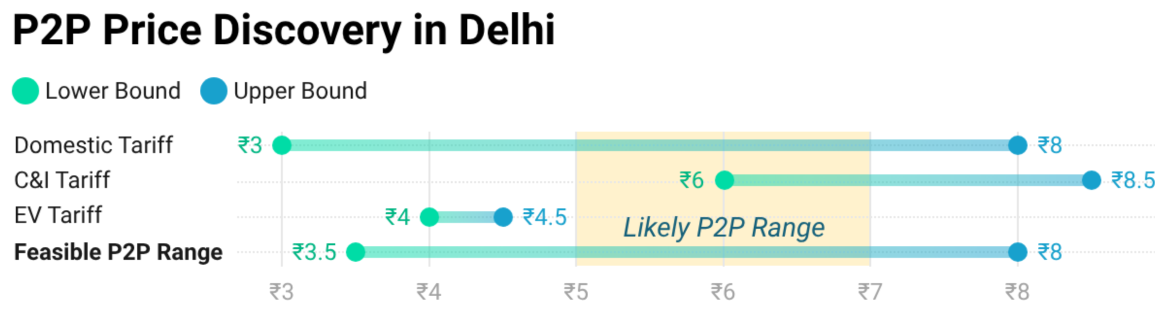

Exhibit 3: Price Discovery for P2P Trades in Delhi

P2P Assessment for Stakeholders

Prosumer Assessment

Participating in P2P energy trading provides fiscal benefits for prosumers. Surplus energy can often be sold at prices higher than the prosumer's own tariff (the benchmark used for net metering), allowing the prosumer to realise greater bill savings. Depending on the size of the RTS installation, for many prosumers, this can translate to enhanced returns from their installations.

Our analysis compares the fiscal benefits of P2P energy trading and NEM in Delhi. The analysis applies time-of-day (ToD) discounts and surcharges, despite Delhi currently lacking such tariffs, because the Ministry of Power has proposed them for national rollout alongside smart meter installation.[1] Further, our analysis considers a representative domestic prosumer with an average monthly electricity consumption of 400 units. Households with this level of consumption are well suited for rooftop solar adoption, as they stand to realise greater economic benefits.[iv]

Domestic prosumers in Delhi with a 3 kW RTS system can expect to recover the RTS capital cost in approximately three years under both NEM and P2P.

[iv] According to BRPL's ARR filing for FY 2024–25, 1.2 lakh domestic consumers (out of 28 lakh total domestic consumers) consumed more than 400 units per month on average, providing a sizeable pool of high-potential candidates for RTS deployment.

Annual net savings are higher in P2P, especially as the discovered price of P2P trades increases. Crucially, while NEM primarily delivers value through monthly bill savings and annual reimbursement for banked NEM credits, P2P unlocks immediate income from energy trades (see **Exhibit 4**).

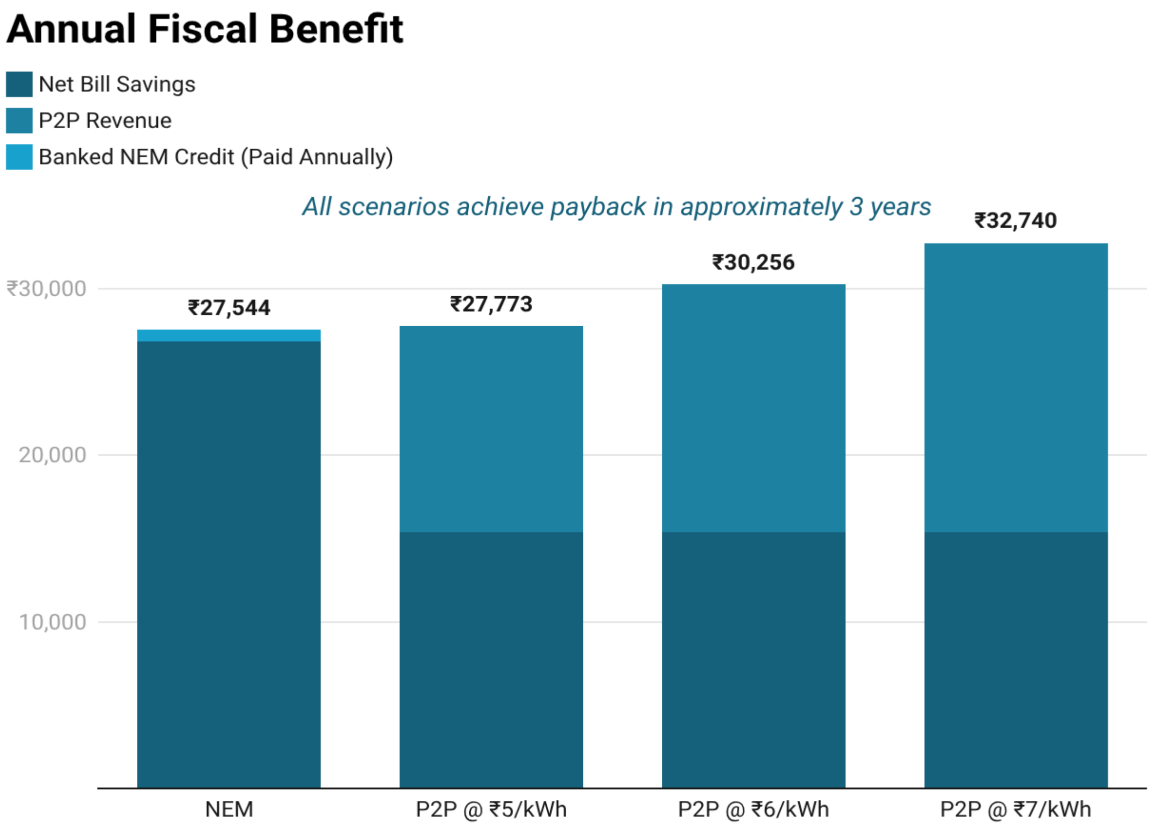

Exhibit 4: Fiscal Benefits for Prosumers of P2P Compared to NEM in Delhi

Consumer Assessment (C&I)

Engaging in P2P energy trading holds financial and strategic benefits for C&I consumers:

1. **Financial benefits:** For C&I consumers whose electricity consumption typically coincides with solar generation, direct bill savings via P2P can be substantial. We find that commercial consumers in Delhi with a peak load of 15 kVA can save 6% to 13% on their electricity bills,

depending on the P2P purchase price and assuming all grid drawl during solar hours is replaced by P2P energy (see **Exhibit 5**).[v]

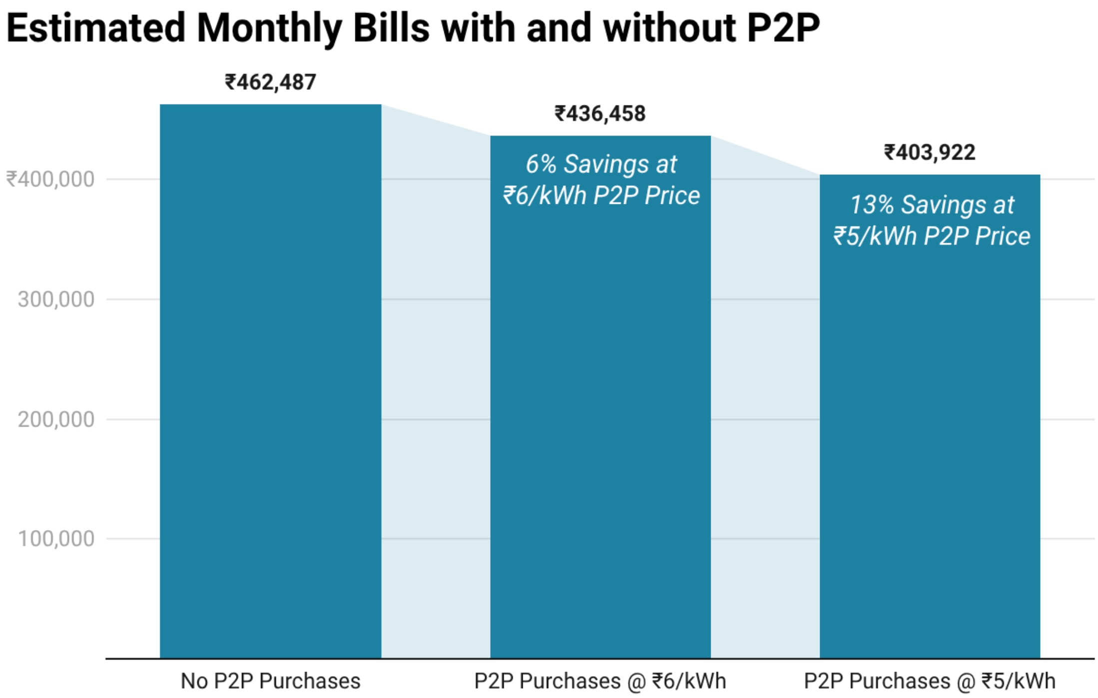

Exhibit 5: Fiscal Benefits for a C&I Consumer Participating in P2P Energy Trading in Delhi

2. **Flexibility:** C&I consumers seeking green energy to lower their energy bills can enjoy greater flexibility with P2P trading as compared to GEOA contracts. Instead of committing to bilateral green PPAs that are tied to a fixed price and volume over a period of 10–15 years, consumers can procure low-cost green energy when they most need it, match purchase volumes to actual consumption, defer purchases in response to market signals, and avoid being locked in to long-term contracts.

3. **Simplicity:** The speed and simplicity of onboarding on the digital P2P platform can help circumvent the steep eligibility requirements and range of charges and restrictions associated with open access

[v] This estimate assumes a medium-sized commercial consumer with a peak load of 15 kVA, annual consumption of 40,000–45,000 units, and a P2P purchase price of ₹5–₹6 per unit. Further, it assumes solar hours are 9 a.m.–5 p.m. Detailed methodology and load shapes are provided in the Appendix.

contracts.[vi, 2] New restrictions on banking of surplus green energy have added to the complexity of open access contracts.[vii] During times of low renewable energy output, consumers cannot utilise banked energy and must purchase expensive grid power. Further, when utilising banked energy, consumers are levied banking charges. Thus, with the cost-saving potential of open access diminished, P2P offers an attractive green energy alternative to C&I consumers.

DISCOM Assessment

P2P energy trading offers fiscal and system-level benefits to DISCOMs despite some revenue loss potential. It can also unlock new models that mitigate power procurement costs and generate additional revenue.

1. **Support renewable obligation targets:** DISCOMs stand to gain significantly by promoting P2P to accelerate RTS adoption. Greater RTS uptake directly helps DISCOMs meet their renewable consumption obligations (RCO), which mandate tripling the share of distributed renewable energy in consumption — from 1.5% today to 4.5% by 2030.

   This requirement is critical for DISCOMs in Delhi, where Delhi Electricity Regulatory Commission (DERC) regulations impose a penalty of ₹0.10 per kWh for any shortfall in meeting renewable energy obligations. But achieving this target can be challenging in Delhi, where fewer than 10% of domestic consumers paid monthly electricity bills exceeding ₹2,000 in April 2024. This share rises to only around 35%–40% during the summer months, when higher cooling demand drives up household electricity consumption.[3] Since P2P offers prosumers the potential to generate income by trading excess generation, it increases the incentive for consumers to adopt RTS.

[vi] To qualify for bilateral contracts under the GEOA rules, the consumer must have at least 100 kW load (higher in some states), either behind a single connection or aggregated across multiple connections. Next, the consumer must involve multiple central and state nodal agencies to acquire all requisite approvals. Finally, the consumer must pay a range of surcharges including transmission and wheeling charges, cross-subsidy, and opaque “other fees and charges.”
[vii] “Banking” refers to the carry forward of surplus green energy to subsequent billing periods.

2. **Distribution loss savings:** By driving RTS adoption, P2P can help stem technical losses incurred by DISCOMs on their distribution network. For example, BSES Rajdhani Power Limited (BRPL) lost an estimated 6.7% of energy sales to technical losses in FY2022–23.[4] By reducing the quantum of electricity flowing on the distribution network, RTS can trim such losses. With some DISCOMs experiencing technical losses greater than 15%, the benefit of driving RTS increases as it reduces DISCOM costs.

3. **Mitigate revenue loss from RTS adoption:** Under NEM, DISCOMs must net off surplus RTS generation against consumption — including during peak periods — and compensate any residual exports at the end of the year at the DISCOM's average cost of supply (ACOS), aggravating their fiscal burden. In contrast, P2P shifts surplus generation exclusively to solar hours, allowing consumption during peak hours to be billed and mitigating the fiscal impact relative to NEM. Amid a national push for ToD tariffs, NEM can further dilute DISCOM revenues by offsetting peak-period consumption with generation during solar hours.

   Moreover, since power purchase costs during solar hours are typically lower than retail tariffs due to abundant solar generation, any loss of energy sales translates into net revenue loss. In a ToD regime, P2P incentivises prosumers to sell excess generation during low-tariff solar hours to C&I consumers, where the revenue loss for the DISCOM would be comparatively lower than a C&I consumer adopting RTS or open access. Further, P2P trading can generate transaction fee revenues for the DISCOM, allowing it to further mitigate net revenue loss from RTS.[5]

   Our analysis of the costs and benefits of P2P energy trading compares the fiscal impact of a 3 kW RTS installation for BRPL under three scenarios. In the first scenario, a domestic customer installs 3 kW of

RTS and utilises NEM, thereby reducing grid drawl.[viii] In the second scenario, the customer sells excess generation via P2P instead of utilising NEM, and in the third scenario, a C&I consumer installs their own RTS or purchases solar via open access (see Error! Reference s ource not found.).

We find that, assuming ToD tariffs are implemented, the highest fiscal impact risk to BRPL comes from a C&I customer adopting solar, given their higher tariffs relative to daytime cost of supply. On the other hand, a domestic customer adopting RTS under NEM results in the lowest revenue loss, because domestic tariffs are lower. P2P offers a balanced pathway — delivering value to prosumers while offering C&I consumers access to lower-cost, local green energy, with reduced revenue risk for the DISCOM from C&I NEM or open access. Moreover, P2P offers DISCOMs an avenue to recover costs, since state regulations permit a wheeling/facilitation charge for every P2P transaction. We also note that while our analysis focuses on a domestic customer with an average monthly consumption of 400 units, BRPL's fiscal impacts from P2P will be lower for domestic customers with lower consumption. Further, P2P offers several system-level benefits as discussed next.

[viii] This analysis uses the same assumptions for the prosumer as in the earlier analyses in this report. The domestic prosumer is assumed to have an average monthly consumption of 400 units, a maximum load of 3.25 kW, and a 3 kW RTS installation. Detailed methodology is provided in the Appendix A.

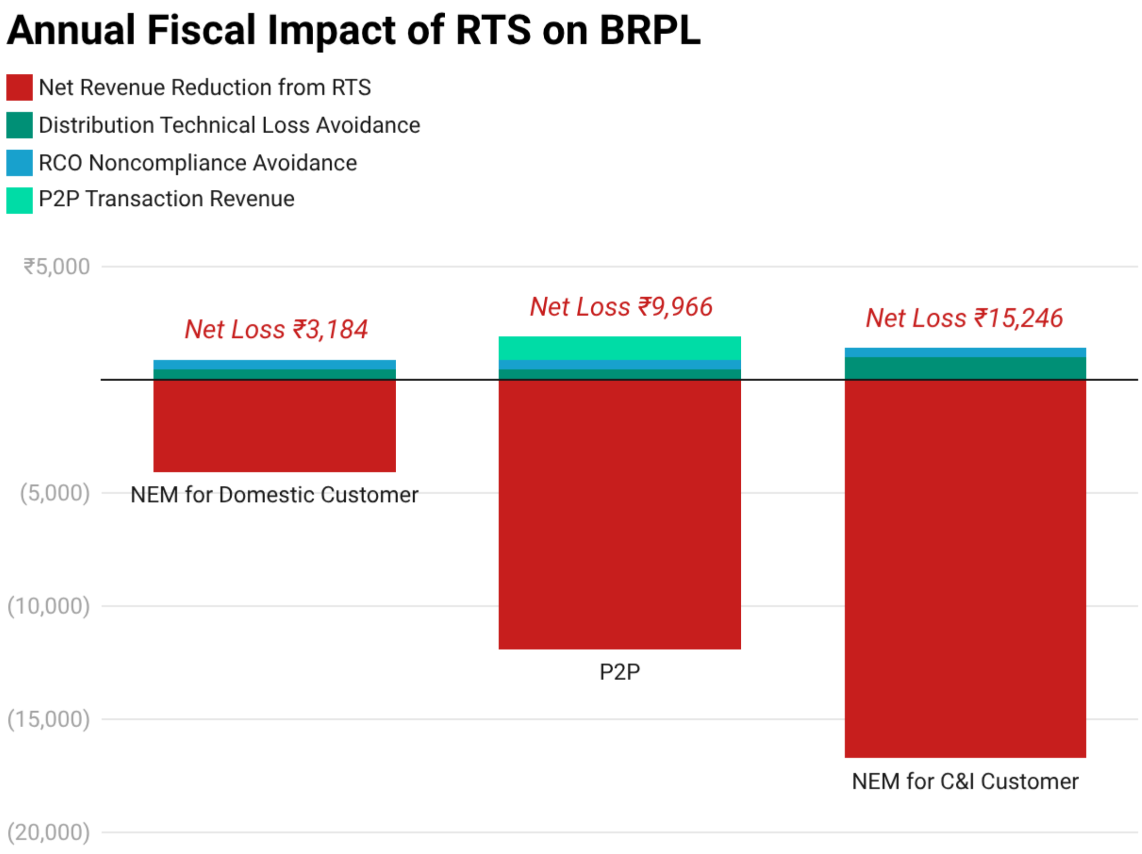

Exhibit 6: Fiscal Impact of 3 kW RTS for the DISCOM

4. **System-level benefits:** As RTS grows, DISCOMs need clear visibility around these assets because they increasingly affect planning, forecasting, and network operations. With more visibility, DISCOMs can assist consumers in detecting underperforming systems and deploy active inverter controls — including voltage support and dynamic export limits — to manage congestion and maintain grid stability.

   Finally, with falling battery storage prices, new aggregator models can be enabled where P2P trading can be conducted during non-solar hours by integrating battery storage at a prosumer's premises. Excess energy stored during the daytime in batteries can be traded with consumers during non-solar hours, minimising the DISCOM's need for procuring expensive electricity during peak periods.

Thus, despite some revenue considerations for DISCOMs, P2P offers several benefits for DISCOMs. By improving network visibility of RTS assets, P2P can enable DISCOMs to enhance their planning and forecasting, congestion management, and adopting a distributed energy marketplace that can be expanded to other grid services like demand response. Importantly, P2P can incentivise aggregators to enter as new market players that orchestrate distributed energy resources for DISCOMs.

Evolution Pathway: From NEM to Distributed Energy Marketplace

P2P energy trading can play a catalytic role in building a digital energy ecosystem by enabling third-party innovators to deliver value-added grid services. As a digitally enabled market mechanism, P2P will require services such as customer onboarding, forecasting and optimisation tools, information technology, and measurement and verification (M&V). This will create space for new market players — aggregators, platform providers, data analytics firms, and M&V providers — to operate alongside DISCOMs.

Further, the use of open, interoperable digital protocols, such as the Beckn protocol, can accelerate ecosystem growth by ensuring that P2P is not a stand-alone project but the genesis of a broader digital energy stack.[ix] Once the foundational infrastructure for identity, asset registry, discovery, contracting, and settlement is established for P2P, the same protocols can be extended for more value-added grid services. Thus, market actors and innovators will have the tools to develop new offerings such as automated demand response, distributed energy storage, and EV charging flexibility. In essence, P2P can become the anchor use case for a scalable, multi-actor energy ecosystem — one in which new services can be built atop a common digital backbone and advance India's digitalisation efforts in the energy sector.

In this context, we envision a four-stage implementation plan for P2P energy trading that can help transform India's distribution sector from traditional NEM to an advanced distributed energy marketplace (see **Exhibit 7**).

[ix] The Beckn protocol is an open, interoperable protocol that enables discovery, communication, and transactions between participants in a digital network without requiring them to operate on the same platform.

Evolution Pathway

Stage 0: NEM	Stage 1: NEM+	Stage 2: Local P2P Exchange	Stage 3: Formal P2P Marketplace	Stage 4: DER Marketplace
Current regime for RTS; NEM offers bill savings	NEM stays for most customers; P2P opt-in introduced for select customer classes	Expand P2P to more customers	Release P2P marketplace to entire DISCOM network	Open marketplace for DER orchestration, e.g., BESS despatch, demand response
Annual true-up for surplus at low export value		Add features like feeder bounds	Formalise all building blocks of P2P marketplace	Integrate with national digitalisation efforts like India Energy Stack
		Conduct sandboxes for new features, regulations, etc.	Fully integrate with monthly billing	

Exhibit 7: Evolution Pathway: From NEM to Distributed Energy Marketplace

1. **Stage 1: NEM+.** NEM stays for most prosumers, but P2P energy trading is introduced as an opt-in for select customer classes. In this stage, P2P trading is accomplished on an MVP (minimum viable product) digital platform that allows basic discovery, ordering, fulfilment, and post-fulfilment settlement.

2. **Stage 2: Local P2P exchange.** P2P energy trading is expanded to more customers, with additional features, such as feeder bounds, included in the digital platform.[x] This will involve creating a sandbox to allow ecosystem service providers (ESP) to test platform features, determine operating costs, and identify challenges. The sandbox will also help the DISCOM discover requisite wheeling charges. Insights from sandbox demonstrations will be shared with regulators to inform regulatory revisions. In this stage, the core components of P2P are tested and formalised, including customer onboarding, asset registry, ordering and settlement of trades, and M&V.

[x] Feeder bounds refer to the ability to limit P2P trades within a distribution feeder's network by limiting transactions between prosumers and consumers connected to the same feeder.

3. **Stage 3: Formalise P2P marketplace.** Based on lessons learned from stages 1 and 2, the P2P marketplace is released to the DISCOM's entire network. In this stage, advanced features are live, such as feeder bounds, multilateral trading (participants trading with multiple counterparties), and store-then-sell through BESS integration. Further, the marketplace delivers seamless integration of P2P settlements with meter data and monthly bill reconciliation.

4. **Stage 4: Distributed energy marketplace.** The P2P marketplace is gradually opened to other DERs and grid services like BESS despatch, demand response, voltage support, and frequency regulation. With an open, interoperable architecture, the distributed energy marketplace allows new services to be built atop a common digital backbone and enables integration with other national digitalisation efforts such as the India Energy Stack.[xi] The marketplace's architecture also includes built-in sandboxing where innovators can test new products, regulators can trial new regulations, and DISCOMs can refine operations.

[xi] India Energy Stack is a proposed national digital public infrastructure (DPI) for the energy and power sector. It is intended to support diverse applications such as digital twin, demand flexibility, and P2P energy trading, and to enable interoperability, transparency, and innovation.

Critical Enablers

In the following sections, we identify several key regulatory, technical, and ecosystem enablers that will be required to minimise entry barriers and create a successful P2P marketplace that evolves into a broader distributed energy marketplace.

Regulatory Enablers

1. **Reduce eligibility requirements:** Regulations must be market-friendly and technology-neutral. Ensuring all customer classes and diverse DERs, including RTS, battery storage, and demand response–ready flexible loads are eligible will encourage market uptake. For example, Karnataka's P2P regulations currently prohibit C&I consumers from participating in P2P.

2. **Role of aggregators and market players:** Regulations must explicitly recognise third-party aggregators as system service providers that can onboard customers, aggregate distributed energy capacity, and provide grid services to the DISCOM. Further, specifying the roles and obligations of each market player — DISCOMs, service developers like independent verification agencies (IVAs), and customers — establishes explicit implementation responsibilities.

3. **Standardisation:** Standardised regulations that are easily replicable can accelerate uptake of P2P by states throughout the country. Common guidelines for M&V frameworks, settlement rules, and eligibility and technical requirements can prevent fragmented implementation. Explicit methodologies for the delineation of fixed-cost recovery for DISCOMs via wheeling charges can address DISCOM concerns of infrastructure strain from increasing distributed generation. Robust protocols for consumer protection, including data privacy and security provisions, grievance redressal frameworks, and clear explanation of charges and penalties, can build trust and transparency. Finally, developing standardised, model P2P regulations

can enable easy and quick adoption by state regulators. Combined, these measures can dismantle barriers to P2P ecosystem expansion.

4. **Regulatory sandbox:** A regulator-approved, fast-track mechanism for DISCOMs to conduct sandboxes to test new features, products, and operations can serve as a gateway for quickly scaling pilot projects to full market integration.

Technical Enablers

1. **Advanced metering infrastructure (AMI):** Monetisation of demand-side grid services relies upon accurate, near-real-time interval data for transparent settlement and reconciliation. Thus, smart meters with 15- or 30-minute interval data and remote data transfer will be crucial for integrating DER-driven grid services. Further, a reliable meter data management system (MDMS), seamless meter data transfer to empanelled service providers, verifiable audit trails, and cybersecurity safeguards for measurement devices will be required to ensure the timely and secure processing of smart meter data.

2. **Open, interoperable communication and device control protocols:** Standardised protocols for device telemetry, discovery and ordering of demand-side services, and transaction layers will support interoperability and modular expansion of the DER marketplace for new products and services.

3. **Data security and identity, consent, and trust layers:** These layers will help build an ecosystem with the requisite trust, informed consent, and data security and privacy protocols vital for customer participation. A marketplace must include, at a minimum, an asset registry that stores unique digital identities for all nodes — users, assets, and aggregators — in the network, a consent management framework with role-based access control, and a decentralised transaction ledger with verifiable audit trails.

4. **Digital platforms:** These will serve as the coordinating layer that supports communication flow between different market players through standardised APIs and open protocols. Digital platforms will be used to conduct several crucial functions including customer onboarding, discovery, ordering, and settlement of transactions, as well as transmission of data between users.

5. **Grid-aware DER infrastructure:** At a minimum, this will include location-aware DERs but may also include readiness for integration with distribution constraints and real-time feeder headroom exposure.

Ecosystem Enablers

1. **Service providers:** These enablers will translate regulatory intent and market design into operational, scalable outcomes. They will provide services like platform development, aggregation and orchestration of DERs, M&V facilitation, and solar and load forecasting. The service providers will allow DISCOMs to focus on system outcomes while unlocking efficiency and innovation in distributed energy services.

2. **Network facilitator and oversight agency:** This entity will set and monitor rules outlining eligibility requirements, technical guidelines, and settlement protocols. It will serve as the market steward, ensuring fair and transparent running of the marketplace, adequate protection for participants, and prevention of discriminatory behaviour.

Conclusion

Peer-to-peer energy trading offers a pragmatic pathway to kick-start India's distribution sector transformation by introducing a transparent, distribution-level market that monetises surplus generation, improves network visibility, and operationalises DERs for beneficial system services. It assigns commercial rights and obligations for DERs in a controlled manner, enabling DISCOMs to move beyond passive accommodation of DERs and towards active coordination of a more flexible grid.

For India, the benefits of P2P extend across customers, DISCOMs, and the state. Prosumers gain a clearer and often superior value proposition compared to net metering, while commercial and industrial consumers can access local green power without long-term contractual lock-in. For DISCOMs, P2P minimises the need for adjusting excess generation during peak hours, enables distributed renewable energy targets to be met, mitigates supply where AT&C losses are high, and maximises the benefits of ToD tariffs while improving forecasting and compliance with RCO.[xii]

Crucially, P2P creates space for new market actors to provide energy services. Aggregators play a central role in translating thousands of distributed resources into system-usable capacity by bundling generation, storage, and flexible demand, managing risk, ensuring measurement and verification, and interfacing with grid operations.

Realising this vision at scale will require action across regulatory, technical, and ecosystem dimensions. Key stakeholders must operate within clearly defined roles supported by standardised market rules, regulatory sandboxes, and cost-recovery mechanisms. Enablers such as advanced metering infrastructure, open and interoperable digital protocols, robust data governance and security, and trusted identity and consent frameworks are foundational to this transition. Eventually, anchored in an open digital architecture, P2P can move beyond a stand-alone market mechanism to become the gateway for a broader distributed energy marketplace,

[xii] Aggregate technical and commercial (AT&C) losses refer to electrical energy that is lost during distribution to end-use consumers through theft, system losses, billing errors, and collection inefficiency.

supporting demand response, storage despatch, EV charging flexibility, and other grid services.

Appendix A

Comparison of Fiscal Benefits of P2P and NEM in Delhi

This section outlines the key assumptions and methodology followed to estimate the fiscal benefits of P2P compared to NEM in Delhi for prosumers with a 3 kW RTS system. The analysis focused on one key metric — net bill savings.

Key Assumptions

- Residential load shape: "Typical" residential load shape calculated using BRPL data for a residential distribution transformer (DT code TP-TGN209A-1) in Shyam Nagar, Delhi, for the period of July 2022 to June 2023
- Representative residential prosumer load characteristics: 11 kVA sanctioned load; 3.25 kVA peak load; 400 units average monthly consumption
- Solar generation profile: Calculated in Python using solar irradiance and temperature data downloaded from the National Solar Radiation Database (NSRDB) by the National Renewable Energy Laboratory (NREL)
- BRPL electricity tariff: Electricity tariff schedule for FY2021–22 along with ToD tariffs as proposed by the Ministry of Power (MoP)
- Power subsidy: ₹0 electricity bill for net consumption of 200 units or less. 50% off electricity bill, up to a maximum discount of ₹800, for net consumption greater than 200 units but less than or equal to 400 units
- RTS characteristics: 3 kWp DC, 16.5% CUF (capacity utilisation factor)
- RTS installed cost: ₹2,15,000 for a 3 kW RTS system
- RTS subsidy: ₹78,000 PM Surya Ghar Yojana subsidy + ₹30,000 Delhi government subsidy + ₹3/kWh Delhi generation-based incentive (GBI) for the first four years

Methodology

Using DT data provided by BRPL, the first step was to generate an hourly load profile for a "typical" residential prosumer — one with an average monthly gross consumption of 400 units and a peak load of approximately 3.25 kVA. Next, using solar irradiance and temperature data, a “typical” RTS generation profile was generated for a 3 kW DC system in Delhi. **Exhibit 8** and **Exhibit 9** show the solar generation profile overlaid on the residential load profile for select months. Next, net load and excess RTS generation were calculated (see **Exhibit 10** and **Exhibit *11***).

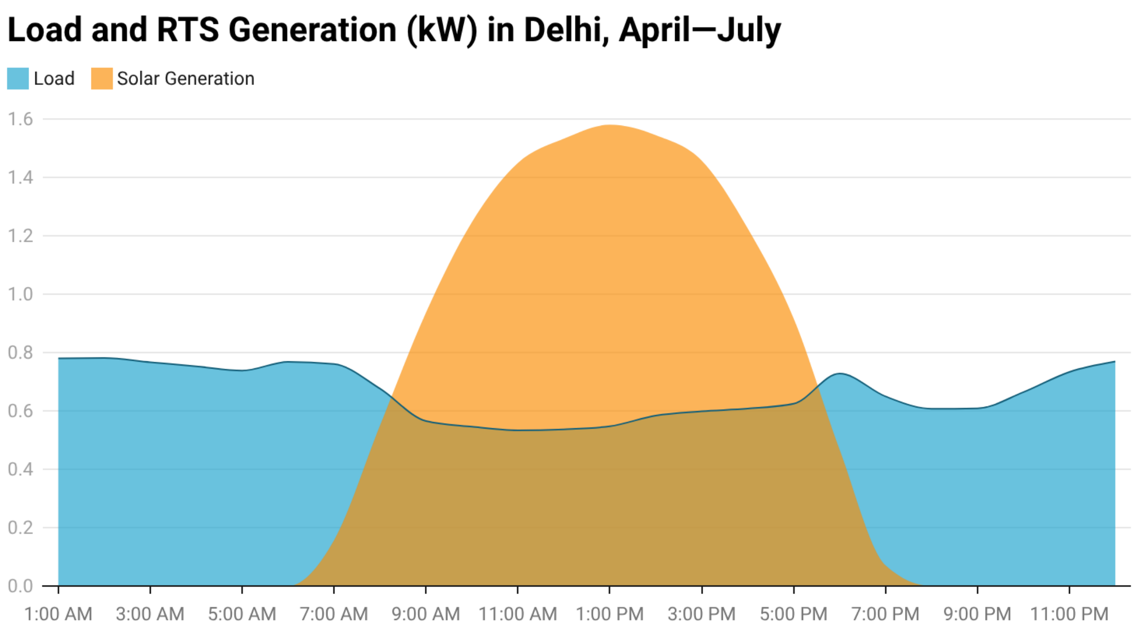

Exhibit 8: Load and RTS Generation Profile for April– July in Delhi

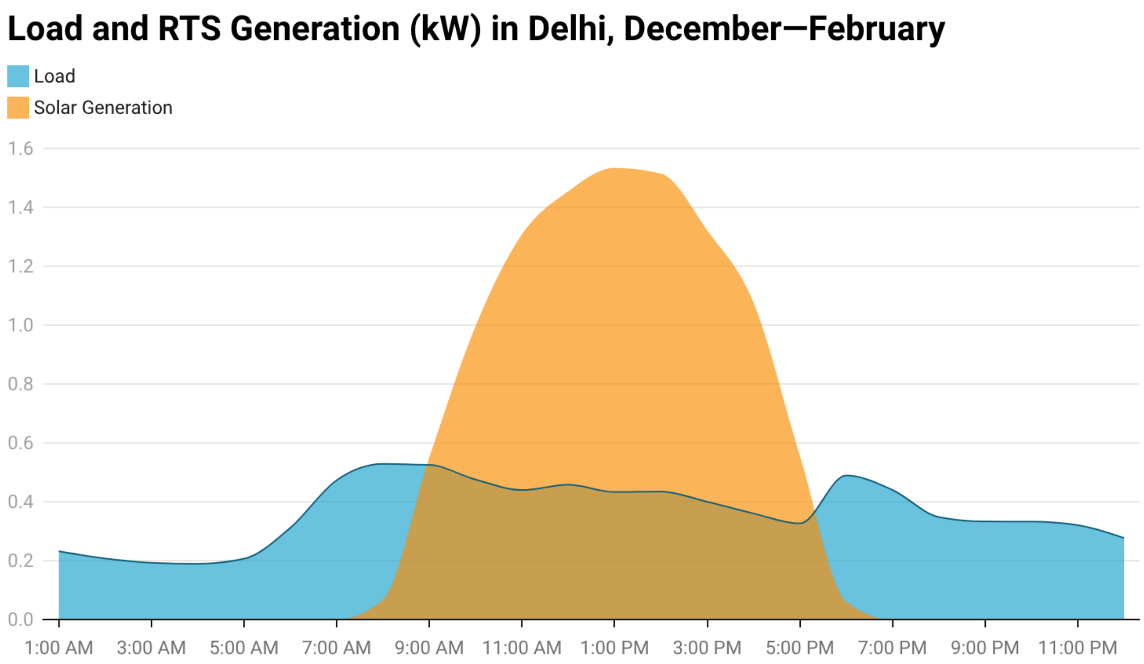

Exhibit 9: Load and RTS Generation Profile for December–February in Delhi

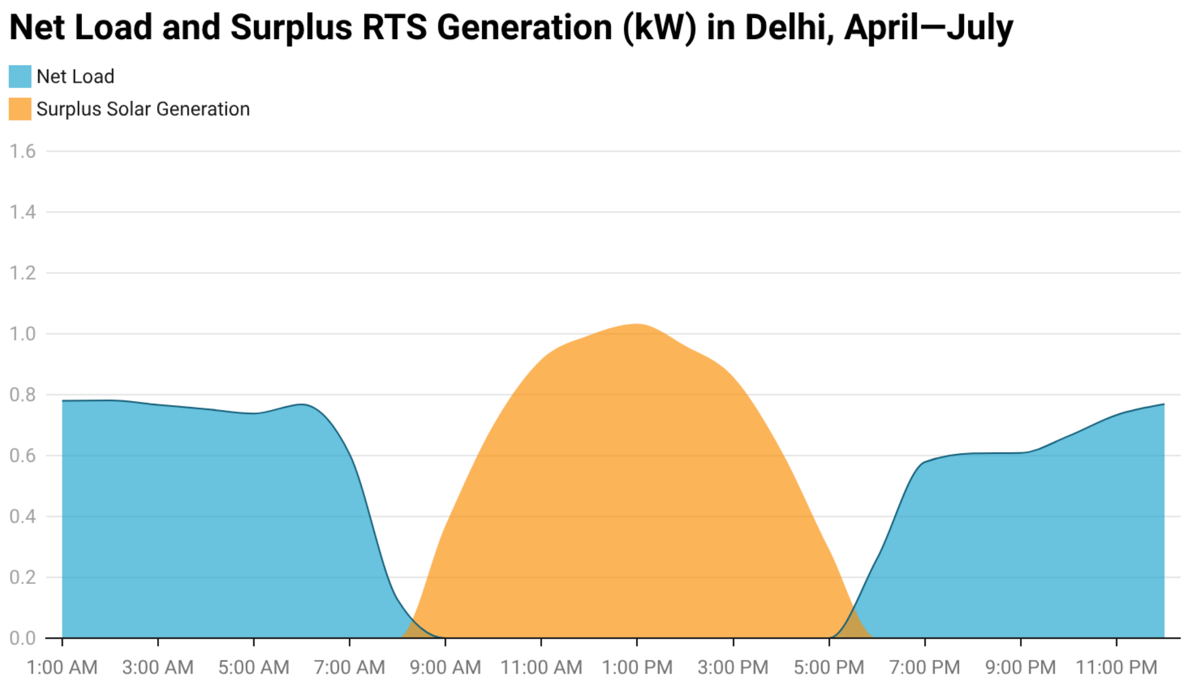

Exhibit 10: Net Load and Surplus RTS Generation for April–July in Delhi

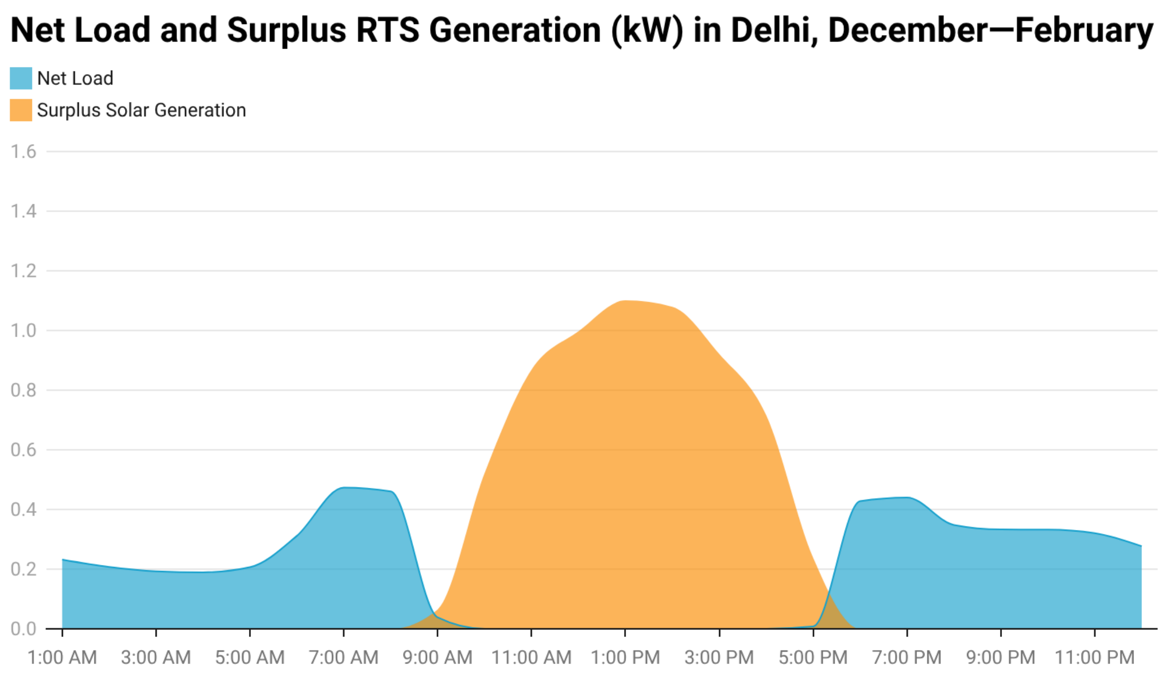

Exhibit 11: Net Load and Surplus RTS Generation for December–February in Delhi

The final step was to estimate the bill savings for a prosumer under NEM and P2P compared to a consumer without RTS. For NEM, net consumption was calculated with solar exports netted against grid imports, while residual surplus was assumed to be compensated at BRPL's ACOS at the end of the year. Then, Delhi's power subsidy was applied to estimate the monthly bill. A similar methodology was followed for P2P, except that surplus solar was assumed sold in the P2P marketplace under three price scenarios: ₹5, ₹6, and ₹7 per unit. The total savings were calculated as the sum of bill savings and P2P sales.

Bill Savings of a Commercial Consumer Participating in P2P Energy Trading

This section outlines the key assumptions and methodology followed to estimate the bill savings for a medium-sized commercial consumer engaging in P2P energy purchases. The analysis focused on one key metric — bill savings under varying volumes of P2P energy purchases.

Key Assumptions

- Commercial load shape: Calculated using BRPL data for a commercial distribution transformer (DT codes TG-PVR066A-4 and TG-PVR066A-2) in Laxmi Nagar, Delhi, for the period of June 2021 to May 2023
- Representative commercial consumer load characteristics: 25 kVA sanctioned load; 15 kVA peak load; 3,500 units average monthly consumption
- Solar generation profile: Calculated in Python using solar irradiance and temperature data downloaded from the National Solar Radiation Database (NSRDB) by the National Renewable Energy Laboratory (NREL)
- BRPL electricity tariff: Electricity tariff schedule for FY2021–22 including ToD tariffs as proposed by MoP
- Average P2P energy purchase price: ₹5–₹6 per unit
- Assumed P2P purchase hours: P2P purchase hours were selected during daytime solar generation hours of 9 a.m.–5 p.m.

Methodology

Using DT data provided by BRPL, the first step was to create an hourly load profile for a medium-sized commercial consumer in Delhi (see **Exhibit 12**). Next, hourly net load was calculated assuming all grid imports during solar hours were replaced by P2P energy purchases. Finally, the monthly bill was estimated using the latest BRPL tariff schedule and ToD rates, and assuming P2P prices of ₹5/kWh and ₹6/kWh. The bill savings were calculated as the difference from the baseline bill (no P2P purchase).

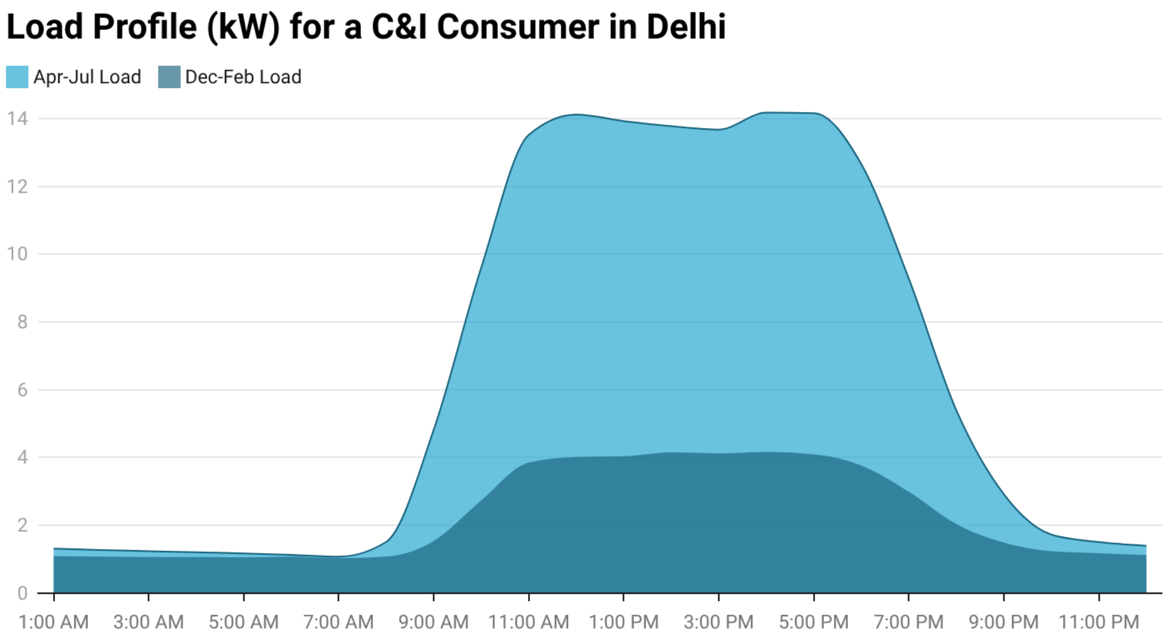

Exhibit 12: Load Profile for a C&I Consumer in Select Months in Delhi

Fiscal Impact of RTS Adoption for BRPL

This section outlines the key assumptions and methodology employed to estimate the fiscal impact of adopting 3 kW of RTS for BRPL. The analysis considers three scenarios — one with a domestic prosumer under NEM, one with a domestic prosumer engaging in P2P trade with a C&I consumer, and one with a C&I consumer procuring its own solar via RTS or open access. The key metrics in the analysis are DISCOM benefits, DISCOM losses, technical loss savings, and RCO noncompliance penalty savings.

Key Assumptions

Key assumptions for the domestic prosumer and C&I consumer are the same as in sections 0 and 0. Other assumptions specific to this analysis are provided below.

- BRPL electricity tariff: Electricity tariff schedule for FY2021–22 including ToD tariffs as proposed by MoP
- BRPL average cost of supply: ₹7.43/kWh
- Estimated BRPL technical losses: 6.7%
- Variable cost of power purchase: ₹3/kWh during solar hours; ₹6/kWh during summer evening peaks; ₹5/kWh during all other hours
- P2P transaction charge: ₹0.42/kWh
- RCO noncompliance costs: 0.10 Rs/kWh

Methodology

To compare the fiscal impact of adopting RTS for BRPL, the first step was to construct three representative scenarios:

1. NEM scenario: Domestic customer installs 3 kW RTS and adopts NEM.
2. P2P scenario: Domestic customer installs 3 kW RTS and sells excess solar generation to C&I customer.
3. C&I adopting solar scenario: C&I customer adopts own 3 kW RTS or purchases equivalent solar energy from open access.

Next, three metrics were considered to estimate the fiscal impact across the three scenarios:

1. **DISCOM net revenue loss:** The net revenue loss from customers switching to RTS under each scenario. Net loss was calculated as the difference between reduction in energy sales and savings from reduced upstream purchases.
2. **Technical loss savings**: Savings for BRPL from reducing energy flows on distribution network.
3. **RCO noncompliance penalty savings:** Avoidance of penalties for BRPL from noncompliance with renewable energy obligations.

The DISCOM net loss was calculated as the difference between the loss in energy sales from prosumers installing RTS and the savings from reduced upstream power purchases. This was calculated by taking the product of net consumption reduction (in kWh) and the difference between the cost of supply and effective tariff (in ₹/kWh) in each scenario. Technical loss savings comprised avoidance of energy losses from curtailing flows on the distribution network. Finally, the RCO noncompliance penalty savings were calculated by taking the product of total RTS generation (in kWh) and the noncompliance penalty (in ₹/kWh).

Endnotes

[1] Amendment to Electricity (Rights of Consumers) Rules 2020, Ministry of Power (MoP), June 2023, https://www.pib.gov.in/PressReleaseIframePage.aspx?PRID=1934673.

[2] Impact of Green Energy Open Access Rules, 2022, Institute for Energy Economics and Financial Analysis (IEEFA), December 2024, https://ieefa.org/sites/default/files/2024-12/Impact%20of%20Green%20Energy%20Open%20Acess_Dec2024.pdf.

[3] "Less Than 30% of Delhiites Got Zero Bill in Peak Season," *Times of India*, October 2024, https://timesofindia.indiatimes.com/city/delhi/delhi-summer-power-bills-spike-less-than-30-receive-zero-bills/articleshow/114226286.cms.

[4] *Petition for Aggregate Approval of True Up of Expenses up to FY 2022-23 & Aggregate revenue Requirement (ARR) for FY 2024-25*, BSES Rajdhani Power Ltd., February 2025, https://www.bsesdelhi.com/documents/55701/1988050144/BRPL_True_Up_FY23_Petition_FY25_Vol_1.pdf/66afbd93-e12a-f918-6928-10ff57ff73eb.

[5] *Order*, Delhi Electricity Regulatory Commission, February 2026, https://www.derc.gov.in/sites/default/files/Order%20in%20Petition%20No.%2002_2026_P2P.pdf.