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RENEWABLE ENERGY PROCUREMENT PERCEPTIONS AMONG COMMERCIAL AND INDUSTRIAL CONSUMERS: CURRENT PRACTICES AND FUTURE POSSIBILITIES

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EXECUTIVE SUMMARY

Highlights

- Indian commercial and industrial (C&I) consumers have been contracting more renewable energy (RE) due to its falling costs.
- Due to cross subsidization, distribution companies (DISCOMs) charge higher tariffs to C&I consumers compared to residential and agricultural consumers. This is one key reason for C&I consumers to shift towards cheaper RE.
- DISCOMs suffer losses because the cost to serve non-C&I consumers is more than what these consumers pay. To offset this, DISCOMS levy additional surcharges, cross subsidy surcharges, and wheeling/banking charges on C&I consumers.
- To retain consumers, DISCOMs are using innovative mechanisms, such as the green tariff (GT). Under this, C&I consumers can opt to buy RE directly from the utility by paying a premium on existing retail tariffs applicable to such consumers.
- This study was conducted to understand the awareness and perceptions of GTs. It was observed that small and medium enterprises (SMEs) are willing to pay a premium to avoid the hassles of negotiating contracts and overcome restrictions under existing procurement methods. Overall awareness of GTs and their adoption is low.
- DISCOMs must take a few steps—such as creating awareness campaigns and designing better GT models—to make these tariffs more attractive to C&I consumers.

CONTENTS

Working Papers contain preliminary research, analysis, findings, and recommendations. They are circulated to stimulate timely discussion and critical feedback and to influence ongoing debate on emerging issues. Most working papers are eventually published in another form and their content may be revised.

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Context

RE procurement is a predominant path taken by organizations to achieve their sustainability targets. Across the world, the GT has been emerging as an alternative RE procurement model for C&I consumers, facilitated by DISCOMs. Through GTs, C&I consumers can opt to buy RE directly from DISCOMs by paying a premium to the utilities. However, GTs suffer from limited adoption in India, primarily due to relatively higher distribution tariffs being paid by C&I consumers. GTs have not been favorably received in states such as Andhra Pradesh and Karnataka. Thus, to design a better GT, it is important to understand how such tariffs are perceived by C&I consumers.

About This Paper

This paper aims to understand the challenges C&I consumers face in the current RE procurement routes. For instance, in a premium-based model, GTs have seen success/higher adoption rates in many Western economies; however, this model has seen a lukewarm response in India. To understand this dichotomy, this paper sets out the following research objectives:

- Develop a greater understanding of the preferred RE procurement routes among C&I consumers and identify key drivers and barriers for each option therein.
- Determine perceptions and acceptability of GTs.
- Estimate the willingness to pay (WTP) for GTs, among the select consumer segments.

To achieve these objectives, data were collected from 101 corporate and 185 SME C&I consumers across five states. These consumers comprised existing RE adopters and nonadopters. A qualitative, in-depth interview study was conducted to understand consumers' perceptions of current RE procurement models, their experiences with the RE transition, and their key RE adoption barriers and drivers. A double-bounded dichotomous choice contingent valuation experiment—a quantitative evaluation method—was used to understand consumers' WTP for GTs.

Findings and Recommendations

We found a dominant preference for on-site solutions for both corporate and SME RE users. Open access (OA) off-site projects (where electricity generated is wheeled from the point of generation to the point of consumption, for a charge) are more popular in large corporations. This is due to the procedural complexities of OA transactions, the larger capital availability in corporations, and the need to meet larger energy demands. Thematic analysis of RE procurement suggests that five RE adoption drivers and seven adoption barriers are impacting the pace of the green energy transition for C&I consumers. We also found that awareness of GTs is strikingly low, with up to 82 percent of corporate consumers and up to 94 percent of SMEs unaware of GTs as a concept and desirous of proof of concept before committing. Perceptions are predominantly negative, with concerns around GT premium longevity, the certainty of 100 percent RE-based supply by DISCOMs, and RE additionality.[1] GTs are more welcomed by SMEs because they are effective instruments to meet RE-based alternate electricity supplies without committing to heavy capital investments (for on-site solutions) or engaging in complex off-site OA transactions. On WTP, 62 percent of corporate consumers and 55 percent of SME consumers were not willing to pay any premium for GTs. This points to the poor acceptability of GTs in a premium-based setting and the need to restructure them with demonstrated proof of concept.

Based on the study findings, this paper presents the following key recommendations for organizations, DISCOMs, and state energy departments (as applicable):

- State energy departments should restructure their GT model with a lower premium but with added adoption (fiscal) incentives. Consumer perceptions demand clarity on GT premium longevity, accompanied by the promise of additionality. Innovative debt financing should be developed for SMEs, which often lack access to easy and affordable financing for RE investments.
- Utilities/DISCOMs should enhance their roles and act as GT information disseminators and promoters, thereby keeping high-paying C&I consumers from migrating from their networks. We also suggest that they offer GTs in a demand aggregated model for SMEs. Under this model, demand from SME clusters can be aggregated by the incumbent distribution utility, which can be met through RE supply, upon payment of GTs.
- C&I consumers, especially large corporations, should play a key role in meeting 100 percent electricity demand through RE with virtual/financial power purchase agreements and virtual net metering (VNM). In Delhi, VNM is already implemented—irrespective of the contracted capacity of the consumer—and is available to all categories of the said DISCOM.

1. CURRENT RENEWABLE ENERGY ADOPTION AMONG COMMERCIAL AND INDUSTRIAL CONSUMERS

In India, renewable energy (RE) capacity reached 104.8 gigawatts (GW) in December 2021 (CEA 2021a). Steady RE capacity addition in the country has been supported by several government policies and missions. The Jawaharlal Nehru National Solar Mission (JNNSM), which launched in 2009, set a target of 20 GW of RE by 2022 (SECI 2009). Subsequently, in 2014, RE targets were enhanced to 175 GW by 2022 (PIB 2021b). This was revised to 500 GW of non–fossil fuel capacity by 2030 at the 26th Conference of Parties at Glasgow, under the United Nations Framework Convention on Climate Change (PIB 2021a).

India's RE growth has been driven by a strong political will to create a favorable environment. During the JNNSM phase, policies such as renewable purchase obligations (RPOs), feed-in tariffs, and 100 percent participation of private players in the RE sector (SECI 2009) played a crucial role in adding solar capacities. Additional policy incentives in the form of central financial assistance,[2] viability gap funding,[3] and tax incentives (such as accelerated depreciation, lower goods and services tax rates, etc.) were also introduced (MNRE 2019). In the wind sector, generation-based incentives[4] and accelerated depreciation are two of the earliest but key policy interventions (Saxena and Rawat 2017), followed by RPOs[5] in 2010 and competitive bidding policies in 2014 (MNRE 2020). Additionally, complementary measures are in place, such as enhancing the role for market-based transactions for RE, having distribution companies (DISCOMs) be the nodal agencies for boosting distributed solar system adoption, increasing RPO targets for state DISCOMs, and making open access (OA) rules more consumer friendly.

The objective here is to understand the challenges faced by commercial and industrial (C&I) consumers in the current RE procurement routes, with special focus on the green tariff (GT). C&I consumers played a key role in India's RE growth story. The C&I segment accounts for 50.7 percent of total electricity consumption in India (MoSPI 2021). Here, we consider the C&I consumers as a single segment because they cross subsidize the residential and agricultural consumers by paying more than the average cost for supplied power (Chatterjee 2020). Due to the high cost of power supplied by DISCOMs, C&I consumers are motivated to produce their own energy through RE-based systems (Aggarwal et al. 2019a; IRENA 2018). In India, C&I consumers procure RE power primarily through the following major routes:

- **Power purchase agreement (PPA):** RE system ownership lies with the generator, and power is supplied to the consumer as per a PPA[6] signed between the two parties. The generator also can be another company with surplus power. The advantage of this model is that there is no capital investment required on the part of the consumer. The consumer only pays for the consumed power and does not bear any responsibility for managing the generating asset. Such arrangements can be made for on-site projects (popularly known as RE service company [RESCO] projects) and off-site systems (known as the OA variant). In 2021, the Ministry of Power (MoP) introduced a draft on OA rules, reducing the eligibility for OA from more than 1 megawatt (MW) to 100 kilowatts (kW). This will usher in new excitement in the OA modes of RE procurement in the coming days.
- **On-site PPA/RESCO:** Consumers can install on-site RE projects, based on rooftop space availability, through a RESCO. RESCOs put in the capital investment, set up the rooftop solar (RTS) generating project, and can also operate and maintain the generation asset as per the contract, signed between the consumer and the RESCO. Consumers can enter into a PPA or a site lease agreement—or a combination of both—with the RESCO (MNRE 2021). Based on applicable state regulations, surplus power from the RTS system can be sold to the grid through a net metering[7] or gross metering[8] mechanism.
- **Off-site PPA/OA:** In this model, power is wheeled from the point of generation to the point of consumption, which can be located in the same state or in separate states. Based on the location of the generation source, interstate and intrastate charges are levied, subject to sanctions for such OA. The period of contract between the generator and the consumer can be long term (12–25 years), medium term (3 months–3 years), or short term (less than a month; FOR 2017). In this model (as in the RESCO model), the consumer benefits from no up-front capital investment and avoids any risks related to running and maintaining the generation asset (FOR 2017). On the downside, the landed cost of power generation may be considerably higher than the generation cost due to additional charges, such as the cross subsidy surcharge (CSS)[9] and the additional surcharge (AS),[10] which are also subjected to frequent regulatory and policy changes.
- **Captive power plant (CPP):** Captive plants are set up by consumers to generate RE power primarily for their own energy use. They can either own it through shareholding in a special purpose vehicle

or by up-front capital investment. These plants can either be on- or off-site, and they may or may not be connected to the grid. For off-site generation plants, the generating consumer applies for OA adhering to the stipulated minimum contract demand as specified by the state regulator for availing electricity from point of generation to consumption. Group CPPs are projects where the ownership lies with multiple users against the conventional CPP, and the power is required to be sourced based on the proportion of the user's shareholding. This procurement strategy benefits the consumer because several regulatory charges, such as the CSS and the AS (excluding off-site captive), are not applicable. The CSS is already exempted under the Electricity Act 2003, and the exemption of the AS was recently upheld by the Supreme Court (SCI 2021). Consumers are also assured of a stable cost of power, are not vulnerable to frequent policy changes or high DISCOM tariffs, and stay insulated from the RPO compliances imposed on the power utilities. However, the key disadvantages are the high up-front capital expenditures for the consumer and the need to submit generation forecasts and schedules. Requisite authorization from government bodies, such as load dispatch centers, nodal agencies, and DISCOMs, also creates operational bottlenecks. In addition, there are certain instances in which the nonapplicability of OA charges is limited to the extent of RPO compliance of the said C&I consumers.

- **RE certificate (REC):** RECs are green attributes that are issued against the generation of electricity from RE resources (IEX n.d.). C&I consumers can purchase RECs to meet their RE compliance needs. There are solar and nonsolar (wind, biomass, and small hydro) categories of RECs. The price of a REC is determined on power exchanges based on REC supply and demand. In the Indian power markets, one REC equals one megawatt-hour (MWh) of RE (REC 2010). The RE generator is accredited by state nodal agencies and then is included in the REC registry by the national load dispatch center (NLDC). Generated electricity is metered and recorded by the NLDC. After that, the eligible entity applies to the NLDC for equivalent RECs. The RE power generated can be sold either to the DISCOMs at the average power purchase cost or to other consumers via OA. The NLDC maintains the record of RECs sold and purchased in the REC registry. The REC is an easy route for RE procurement while also meeting RE obligations on the part of the consumer. However, since RECs are market-based instruments, they are exposed to price fluctuations resulting from demand-supply mismatch of certificates in the exchange (along with other regulatory interferences) and also add to the cost of power purchase (in addition to paying for regular DISCOM supplied power costs). In addition, some C&I consumers also want their RE procurement to result in additional RE capacity; hence, they do not prefer RECs as a route to green their electricity.

1.1 C&I Renewable Capacity and Market Penetration

Of the total 104.8 GW RE installed capacity in 2021, 17.1 GW come from the C&I consumer segment.[11] Of this, wind capacities accounted for 3.5 GW (OA and captive), and solar capacities equaled 13.6 GW, of which RTS capacities amounted to 5.5 GW (BTI 2021). Solar power capacities (especially RTS) increasingly have been added over the last two years due to the availability of good solar irradiance/resources, easier on-ground implementation (many solar power developers operate in the market today), and easier maintenance of solar projects.

The growth of RTS capacities has been led by the C&I segment, which accounts for more than 75 percent of the rooftop market share. Annual capacity additions have been around 1.5 GW (Gulia et al. 2021b). The capital expenditures (CAPEX) model (where consumers put in their own capital) has been preferred over the RESCO models, accounting for 84 percent of total installations (USAID and MNRE 2018). Despite the COVID-19 pandemic, RTS solutions have been a popular choice for C&I consumers to optimize power costs. On-site solar capacity addition is expected to reach 1,875 MW in fiscal year (FY) 2022, recording a 47 percent improvement from FY2021 (Gulia et al. 2021a). Recent data shows that solar is the cheapest power procurement option, averaging ₹3.50–₹3.75 per unit (BTI 2021), compared to C&I consumers' average billing rate of ₹7–₹10/unit.[12]

In OA, through the PPA route, C&I consumers prefer to source their power from experienced RE generators, with expertise in land acquisition, grid connectivity, and risk management. However, backlash from DISCOMs against OA RE has resulted in the withdrawal of exemptions in states such as Andhra Pradesh, Karnataka, and Maharashtra (JMK Research & Analytics 2019). Along with the implementation challenges of account settlements, OA solar installation capacity was only 1.2 GW in 2021 (Gulia et al. 2021a). In REC markets, certificate purchases by C&I consumers increased until FY2019, when the total REC equivalent of 2.3 GW was sold (POSOCO 2019). But with limited REC demand in FY2020, the trading volumes have declined considerably. This has forced projects registered under a REC to shift to OA (Aggarwal et al. 2019a), and the resulting short supply of certificates has increased REC prices.

Hence, consumers are considering other ways of procuring RE because the overall cost of brown power plus a REC is much higher when compared to other models. In a recent move, the Central Electricity Regulatory Commission (CERC) revised REC prices by removing the floor price and fixing the forbearance price of ₹1,000/MWh (Sirdeshmukh 2020). This may help noncompliant entities (including DISCOMs) fulfill their RPO targets at lower prices and may lead to an increase in demand for RECs in the coming years.

1.2 The DISCOM Dilemma

With falling RE prices, C&I consumers find opportunities to "migrate" out of the DISCOM supply network. However, given the intermittent nature of RE power, C&I consumers are unable to do so. This creates uncertainty in electricity demand management for DISCOMs because C&I consumers' operations are not necessarily revealed. In this way, C&I consumer migration to cheaper RE power creates two problems for DISCOMs: they lose high-paying consumers from their distribution networks, and they face higher uncertainties in energy demand management, which requires planning for 24/7 reliability strategies. DISCOMs are also unable to benefit from falling RE costs because they are contractually bound by old PPAs that involve expensive fossil fuels. Given these dynamics, DISCOMs are actively using the measures allowed in the Electricity Act, such as provisions to increase wheeling/banking charges for RE power and to impose OA surcharges to dissuade C&I consumer migration towards their own RE generation.

These issues call for new thinking in RE procurement among C&I consumers. A mechanism needs to be developed that would be beneficial for both DISCOMs and C&I consumers—one that will retain C&I consumers in the DISCOM network yet enable them to meet their green energy migration/transition plans.

2. UPCOMING RE PROCUREMENT ROUTES

This study tasks itself with better understanding the drivers and barriers to all RE procurement models, with special focus on GTs. In addition, it also investigates the perceptions, awareness, and the willingness to pay (WTP) for premium-based GTs among C&I consumers in five Indian states. It explores the ways and means to promote GTs among C&I consumers, and it suggests new RE market interventions/products to boost RE procurement among C&I consumers while protecting revenue losses for DISCOMs. One option for addressing consumer migration and the loss of revenue to DISCOMs is the GT model. Under this model, the C&I consumer typically enters a long-term contract to purchase RE (and associated energy attribute certificates) provided by the DISCOM. The energy generated is usually from a determined resource or asset (Barua 2017; IRENA 2018). These energy attribute certificates are like guarantees of origin in Europe. GTs have gained popularity for many reasons, including the following: they are able to source 100 percent of the energy requirement from RE, save on the up-front capital investment in RE yet reap the benefits of RE usage, provide price predictability for C&I consumers as they get into long-term arrangement with DISCOMs, and help utilities prevent C&I consumer migration (Krishnan et al. 2020). GTs are offered in several formats in electricity markets around the world. However, they are mostly classified into three different models:

Consumers directly engage with RE producers for tariffs. DISCOMs have no role to play apart from facilitating access to transmission and other networks for consumers, for which charges are levied. This would be similar to the current role they play as DISCOMs.

- DISCOMs procure and provide RE-based electricity supply to the consumer, and the GT is collected as a premium for the services provided.
- The tariff is a market-based mechanism linked to the market price of RE. This assures that consumers benefit from lower market prices, but it also increases exposure to market volatility and shocks (Wilson 2021).

Of the three models, often the premium-based model is adopted because consumers pay for the investments in RE that are required (Diaz-Rainey and Ashton 2011) and premiums capture the public preference for a green product (Kowalska-Pyzalska 2019). This model has garnered mixed reactions in different countries. In the Netherlands, consumers opting for GTs increased due to additional fiscal incentives such as tax exemptions provided by DISCOMs (Diaz-Rainey and Ashton 2011). However, in the United Kingdom, consumer opt ins for GTs have been slower than expected (MacPherson and Lange 2012). German consumers appear to have the most appetite for paying the premium and opting for GTs in Europe (Sundt and Rehdanz 2015).

2.1 India's Experience with the Premium-Based Model

Currently in India, the GT model has been explicitly introduced in three states: Andhra Pradesh, Karnataka, and Maharashtra. In Andhra Pradesh, the tariff is a higher-demand charge with no fixed charges. In Karnataka, the GT premium is set on the existing commercial tariff. In Maharashtra, GTs are available in short-term opt-in formats and are open to residential consumers.

In all states, it is voluntary for consumers to opt in for GTs. The premium is calculated by using a formula based on the difference between the traditional tariff and the RE purchase tariff.[13] In both Andhra Pradesh and Karnataka, the uptake is currently low because of the long-standing practice of cross subsidization of electricity prices in India. Unlike the rest of the world (where residential consumers pay higher rates than C&I consumers), Indian C&I consumers pay more for power consumption than residential and agricultural consumers. This cross subsidy helps supply power at lower cost to poorer sections of the population. Thus, an instrument that would increase tariffs for C&I consumers would not be welcomed.

3. RESEARCH OBJECTIVES, QUESTIONS, AND METHODOLOGY

3.1 Research Methodology

The primary objective of this study was to explore the preferred RE procurement practices among C&I consumers in India and to recommend new RE business models that encourage higher RE adoption among current nonadopters. This study was undertaken in five Indian states: Delhi–National Capital Region, Gujarat, Kerala, Tamil Nadu, and Telangana. The following three research objectives were formed:

- To explore current preferred methods of RE adoption/procurement among the C&I consumers and identify RE adoption drivers and barriers
- To study perceptions of GTs (RE adopters and nonadopters)
- To estimate C&I consumers' WTP for GTs

Data were collected from RE adopters[14] and nonadopters[15] from corporate[16] and small and medium enterprise (SME)[17] C&I consumers. Qualitative methods such as in-depth semistructured interviews were conducted and recorded virtually with respondent approval; they were then transcribed and analyzed between April and September 2021. The interview questions were based on detailed discussion guides formulated separately for adopters and nonadopters (see Appendix A). For RE adopters, questions focused on their preferred RE procurement model, what encouraged them to adopt RE, the barriers they faced in the adoption process, their current adoption of storage systems, and their views on the GT program. For nonadopters, interview questions focused on understanding their reasons for nonadoption, their opinions on how RE adoption can be accelerated, their future plans for RE procurement, and their willingness to opt for GTs.

For both adopters and nonadopters, a quantitative assessment of WTP for GTs was conducted using a double-bounded dichotomous choice contingent valuation (DBDC-CV) experiment. Each respondent was first given a GT information sheet that explained GTs in India and how they are currently structured in states that offer them (see Appendix B). Through this information sheet, the respondent became familiar with the GT mechanism, its benefits, and the additional costs that might accrue for the adopting consumer. Based on this information, respondents were first asked if they would be willing to pay a premium of ₹1/unit/month on their per unit cost. If they said yes, they were asked if they would be willing to pay a premium of ₹2/unit/month. If they said no, they were asked if they would be willing to pay a premium of ₹0.50/unit/month. The experiment ended after two rounds.

The DBDC-CV method was chosen because it has been used extensively in literature in eliciting consumers' WTP for RE products (Abdullah and Jeanty 2011; Lee and Heo 2016; Xie and Zhao 2018). It is well known for reducing response fatigue (Hanemann et al. 1991) and mimics a more market-like setting (where consumers face a yes or no decision while making an actual transaction; Loomis 1990). The premium values were kept close to actual GT premiums being charged by Indian states such as Andhra Pradesh and Maharashtra.

3.1.1 Sample inclusion criteria, data collection, and sampling strategy

Purposive sampling[18] was used to reach targeted respondents and to gather rich insights on the research questions framed. Inclusion criteria helped select the right study participants so that data collected are rich and insightful. Typical respondents (both adopters and nonadopters) held key decision-making power within the organizations they represented. In addition, for RE adopters in both consumer clusters, a typical respondent was aware of the RE system (year of adoption, cost incurred, and electricity generation) and its benefits and issues. Inclusion criteria were communicated during respondent recruitment and through the study's introductory e-mail, which guided us to the right authority within the organization (Charmaz 2006). Each C&I organization represented one study respondent. However, different RE projects in different states, for the same organization, were considered as independent samples (because RE projects in different states render different experiences and consumer perceptions). Respondents already interviewed were asked to refer to other potential C&I consumers, who could be a part of the study. Hence, this study relied on both purposive and snowball sampling. For the SME segment, publicly

Table 1 | **Breakdown of Respondents Approached and Actual Responses Received**

	DELHI-NCR	GUJARAT	KERALA	TAMIL NADU	TELANGANA	TOTAL
SME RE	240	189	242	190	223	1,084
SME non-RE	178	167	195	170	158	868
Corporate RE	115	85	58	83	72	413
Corporate non-RE	85	65	49	72	56	327
Total	**618**	**506**	**544**	**515**	**509**	**2,692**

Notes: NCR = National Capital Region; RE = renewable energy; SME = small and medium enterprise.
Source: WRI authors.

available databases were used to identify the sampling frame. Once identified, e-mails and calls were placed to recruit respondents. For corporate consumers, the existing network of C&I consumers was tapped, which helped expand the sample base. Data collection was conducted by a team of trained enumerators with local state presence and local language proficiency to help in seamless data collection and subsequent transcription. Field enumerators were trained to conduct semistructured interviews, the DBDC-CV experiment (Whittington 2002), and to ask open-ended questions, such that the ensuing text data collected could be meaningfully analyzed at a later stage (Charmaz 2006).

3.2 Data Analysis

Quantitative data on the WTP for GTs were analyzed using the DBDC-CV framework. Simultaneously, text data collected from the interviews were studied and analyzed using grounded theory methodology (Glaser and Strauss 1999) the analysis of text data that provides much richer insights (Walker and Myrick 2006). Thematic text analysis was conducted in three stages. In the first stage, in vivo codes were developed by coding each line separately. In the second stage, similar in vivo codes were grouped under aggregate codes. Finally, similar aggregated codes formulated themes/factors. The text analysis conducted helped identify 12 key themes originating from the data: five drivers of RE procurement and seven barriers that slow down RE purchase among C&I consumers. Throughout the analysis, a constant comparison method was adopted in which data were analyzed as soon as they were collected (Kolb 2012). This ensured that continuous feedback was provided to the data collection process until data saturation was observed and no new codes were generated (Fusch and Ness 2015)—that is, no new information emanated from interviews. In the end, the analysis generated more than 200 line-by-line codes, 32 aggregate themes, and 12 key themes in each consumer category.

4. KEY FINDINGS

This section reports the key findings from the study, based on a qualitative assessment of 101 corporate and 185 SME in-depth interviews. A state-wise summary of data collected appears in Table 2.

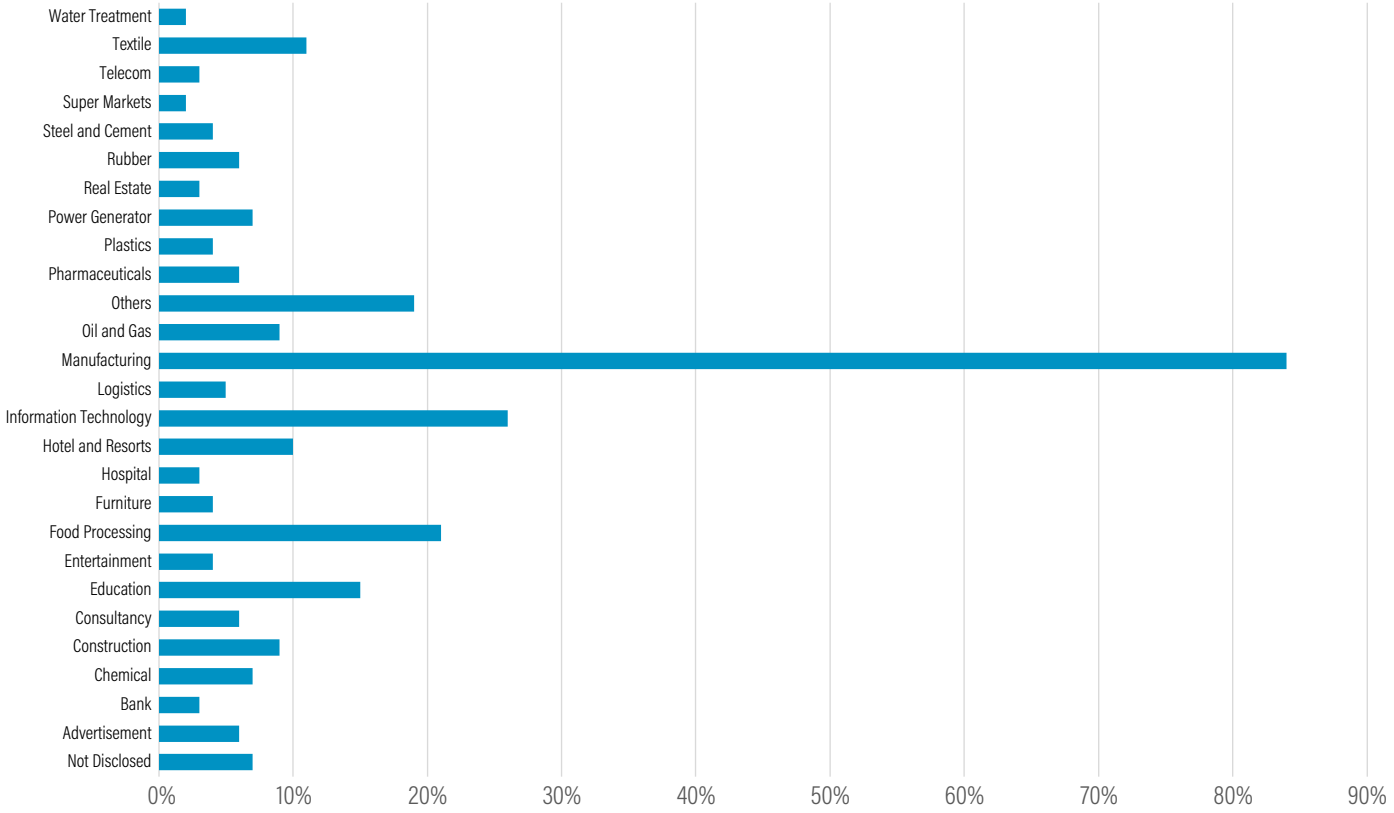
Figures 1–4 detail respondent demographics.

Table 2 | State-Wise Summary of Interviews Conducted

STATE	CORPORATIONS		SMALL AND MEDIUM ENTERPRISES	
	RE ADOPTERS	NONADOPTERS	RE ADOPTERS	NONADOPTERS
Delhi–NCR	14	9	16	19
Gujarat	6	12	20	17
Kerala	9	7	17	18
Tamil Nadu	12	13	19	21
Telangana	11	8	17	21
Total	**52**	**49**	**89**	**96**

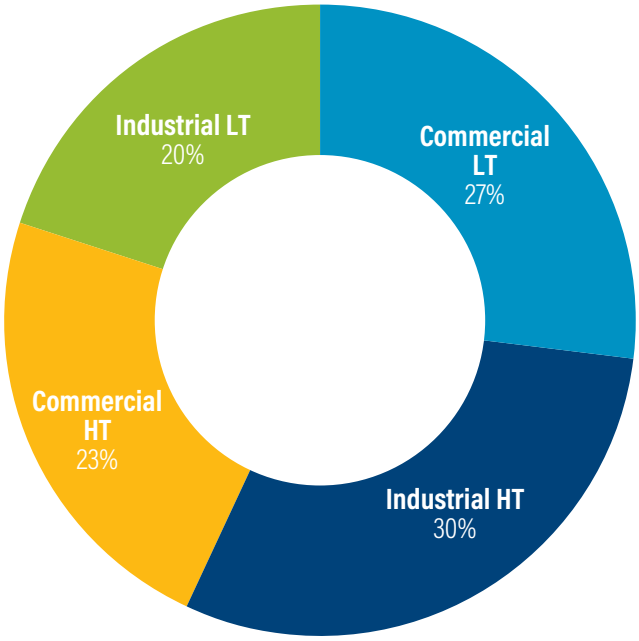
Notes: NCR = National Capital Region; RE = renewable energy.
Source: WRI authors.

Figure 1 | Respondent Industry Mix



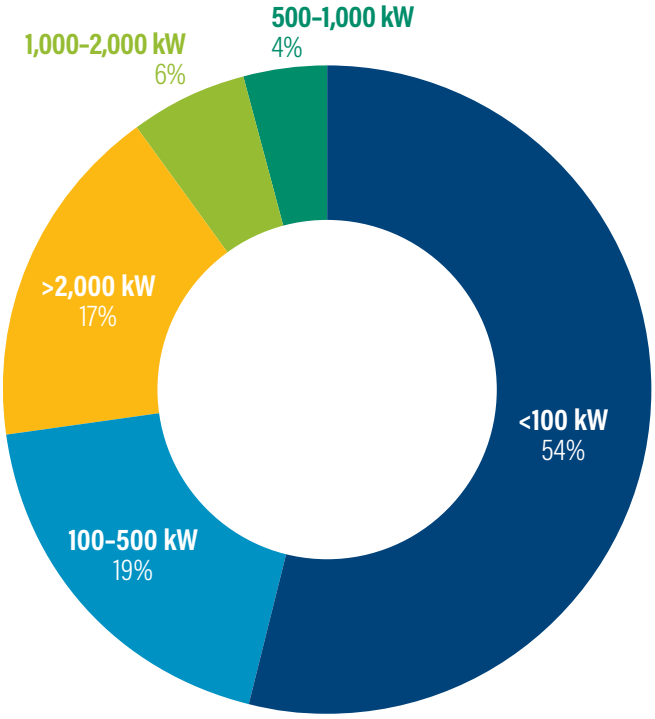
Source: WRI authors.

Figure 2 | **Equal Split of Respondents in Low-Tension and High-Tension Categories**



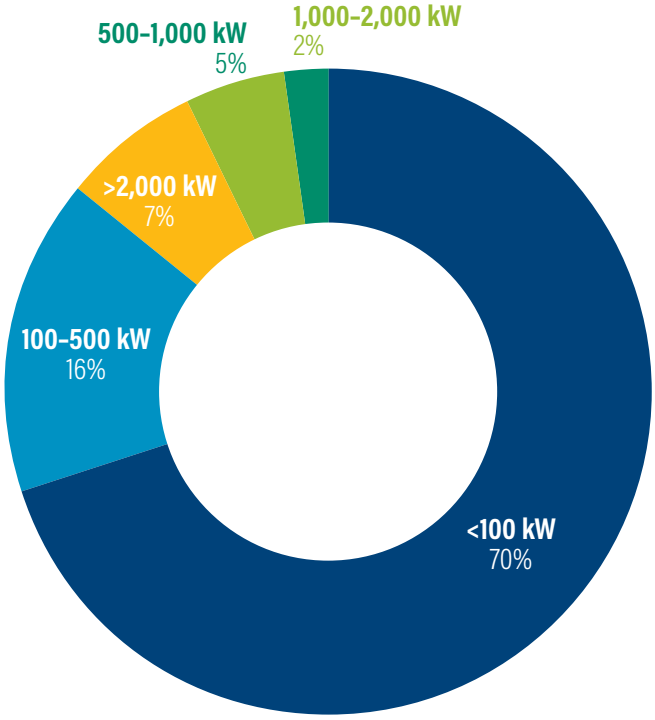
Notes: HT = high tension; LT = low tension; n = 243.
Source: WRI authors.

Figure 3 | **Contracted Load with Utility**



Note: Most consumers have less than 100 kilowatts (kW) connected load (n = 167).
Source: WRI authors.

Figure 4 | **RE Capacities with RE Adopters**



Notes: Note: Less than 100 kilowatt (kW) capacities are more prevalent (n = 130).
Source: WRI authors.

4.1 RE Procurement in Large Corporations and SMEs: Drivers and Barriers

Thematic text analysis conducted on 101 corporate and 185 SME respondents revealed that RE procurement by C&I consumers is affected by 12 distinct factors: five drivers and seven barriers. The barriers deter initial RE adoption for nonadopters and delay RE expansion plans among adopters. The identified drivers and barriers are discussed below.

4.1.1 Drivers

- **Economic/financial:** As many as 31 out of 60 corporate and 76 out of 89 SME RE users found RE solutions to deliver cheaper power supply, shorter investment paybacks, and attractive returns on investment. The CAPEX model (where investors invest their own capital) is the most preferred mode for RE adoption among the corporate users. Of the corporate adopters, 43 out of 60 suggested that capital was accessible and they had organizational support for adopting the CAPEX route over third-party models. Corporate nonadopters preferred third-party PPA arrangements and on-site solutions (20 out of 49 respondents) over off-site captive arrangements due to heavy capital commitments in the CPP

case. Central and state government subsidies and tax concessions are crucial for SMEs to make RE installations affordable and viable for investment. Existing government assistance is crucial to SMEs because they lack access to capital from the market/lending institutions. Of SME nonadopters, 17 out of 96 also reported bank loans to be the preferred route for RTS financing because the loan can be paid off in a short time.

- **Organizational:** Of adopters, 28 out of 60 had dedicated RE commitments and 10 were mandated by their business partners to source power from RE sources. Overall, 60 percent of the adopters had future expansion plans to explore new ways to procure more RE. A few corporations had even committed to the RE100 initiative and were exploring both on-site and off-site solutions. Of SME adopters, 28 out of 89 were mainly investing to understand the complete benefits of RE. These investments help them get more information on the economics of RE and the various adoption models available in the market (RESCO and CAPEX). It was observed that, among the nonadopters, there are plans for future adoptions of RE (19 out of 49 for corporations and 36 out of 96 for SMEs).
- **Operational:** For corporations, the RESCO model provides minimum operational commitments and maximum technical expertise; however, the CAPEX model of investing still dominates corporate RE strategy. For SMEs, system maintenance under contract with developers is a major plus, easing operational worries (Pandey 2019). For SME nonadopters, RE also promises better energy access with greater reliability because many SMEs reported intermittent grid supplies that affected business operations.
- **Technological:** RE-plus-storage models offer self-sufficiency (in off-grid on-site systems), but evidence of RE-plus-storage systems are limited in both corporate and SME adopter segments. Further, both consumer segments welcomed equipment warranties (extended by developers) in areas with climate uncertainties, especially in remote areas with unreliable grid supply (10 percent of corporate adopters).
- **Social:** In the survey, 33 percent of corporate and 35 percent of SME respondents acknowledged that they had adopted RE after their peers had done so. The corporations used the tender process (mostly the lowest-cost bidder route, where the lowest bidder is awarded the project). The SMEs relied on personal networks and word of mouth from adopters to select developers. This corroborates existing literature that establishes the significant role of peer effects in accelerating the diffusion of RTS systems (Bollinger and Gillingham 2012; Curtius et al. 2018; Graziano et al. 2019).

4.1.2 Barriers

The following seven key barriers determine the RE procurement choices for the SME and corporate consumers:

Regulatory/bureaucratic: There is a perception among the respondents (9 percent) that OA is only for large consumers due to the current minimum capacity requirement of 1 MW. The recent draft regulation by MoP suggests bringing down the minimum sanction load to 100 kW (MoP 2021). This might spur demand for OA in the SME segments. Of corporate users, 25 percent suggested that their expansion plans were impacted by frequent changes in RE regulations that make the projects economically nonviable. Other policy and regulatory issues, such as delayed approvals and subsidy disbursements (11 out of 60 corporate adopters and 27 out of 96 SME adopters) and delays in acquiring metering approvals/arrangements (5.5 percent of the sample), are major issues faced by the consumers. The respondents reported that the RTS segment was impacted due to states withdrawing net metering facilities. The gross metering options (where prosumers are paid for electricity fed into the grid at the rate of the feed-in tariff) were unattractive for consumers due to the existing disparity between feed-in tariffs and distribution tariffs. Finally, the regulatory complexities of OA transactions deter SME nonadopters from exploring the OA route (10 percent). Some corporate respondents referred to the absence of solar cell policy as an issue that needs to be addressed.

- **Technological:** First, the technical performance of wind projects and generation uncertainties resulted in an overall bad perception for OA wind projects (11 percent respondents). This demonstrates the importance of technological factors defining the success of wind projects (Kulkarni et al. 2016). Second, grid unavailability rendered on-grid projects vulnerable and resulted in revenue losses. Third, in the case of RTS, lower generation due to panel degradation raised concerns by consumers about developer generation commitments at the time of installation. This affects the project payback period. The current efficiency of RTS systems only meets 20–25 percent of the corporate energy demands. Hence, going for more solar involves higher capital commitments and roof availability, suggesting the need for space-efficient RTS technologies. Almost 8 percent of SME adopters suggested that weather-resilient (cyclone-

and lightning-resistant) RTS systems would be key for improving the adoption rate for businesses in remote areas.

- **Organizational:** Both corporate and SME consumers raised concerns about the loss of aesthetic value due to RTS installations. This indicates a "space loss aversion," which also is observed in developed economies (Scarpa and Willis 2010). Consumers often object to rooftop systems, believing they diminish the aesthetic and hedonic valuation[19] of the property (Gaur 2021).
- **Operational/logistical:** Roof-space availability and ownership of rooftops is a major barrier for RTS adoption among both corporations and SMEs. These rented spaces are often old structures, which are too weak for RTS installation. Close to 15–20 percent of nonadopters across five states reported this as an important operational issue for adoption. In addition, 10 percent of nonadopters argued that a lack of sufficient energy demand is a reason for nonadoption. For adopters, issues such as the maintenance of systems and the availability of climate-resilient modules are some prominent causes of concern (Ginoya et al. 2021). Specifically for OA consumers, locating land/infrastructure tie-ups creates logistical barriers.
- **Economic/financial:** High initial capital costs remain the biggest concern for 27 percent of SME nonadopters and 35 percent of corporate nonadopters. The SME respondents argued that innovative financing is needed to enhance the adoption rate of RE; they find government assistance and the commercial bank lending process to be insufficient. Recently, the SMEs suffered from the COVID-19 lockdown, which has affected the overall energy demand. The lockdown has induced permanent changes in working load in offices (Shekhar et al. 2021). This has made it more challenging for SMEs to undertake the additional RE cost adoption. The lenders also became prudent about the servicing of loans in such a subdued SME environment, exacerbating the financing of RE projects (Gulia et al. 2021a).
- **Social/institutional:** The peer-to-peer network is very important in the uptake of RE among consumers (Bollinger and Gillingham 2012). In our survey, the lack of such networks is evident among 18 percent of corporate nonadopters. The survey found that 50 percent of nonadopters were never approached by developers. This suggests that peer networks are weak among the C&I consumers. Only 1 percent of adopters reported that they benefited from the role of government nodal agencies to diffuse information and benefits of RE. There is a general perception (3 percent of the total respondents) that the government nodal agencies are not in favor of RE. About 14.6 percent of SME nonadopters reported a preference for private players in getting information on RE.
- **Consumer information:** Access to information about and awareness of RE technology is key to enhanced adoption (Wall et al. 2021). The survey suggested that there is general lack of awareness among consumers. Fifty-nine percent of corporate nonadopters suggested that they needed more information regarding RE system costs, benefits, adoption models, and operations before they could make an informed decision about adoption. In general, information on the payback period and financial calculations were incomplete for corporate and SME consumers. About 3 percent of corporate adopters and 33 percent of SME adopters reported an incomplete understanding about financial calculations around payback. For nonadopters, this is more profound (60 percent of corporate respondents). Thirty-nine percent of SME nonadopters opined about access to more information on financials and payback periods. This suggests that information about and awareness of system economics and the payback period is largely deficient among the SMEs and needs immediate attention.

4.2 Battery-Enabled Storage Solutions: Perspectives from Corporate and SME C&I Consumers

Adoption of battery-enabled storage solutions (BESSs) among C&I consumers is slowly picking up pace due to falling costs and improved technology (Deorah et al. 2020). Existing literature highlights the predominant drivers and barriers to BESS acceptance (Kuldeep et al. 2016). With increasing behind-the-meter applications (Zinaman et al. 2020), developments in storage technology, and enabling regulations, policies, and incentives, more C&I consumers will adopt BESS solutions.

Yet, in general, both corporations and SMEs continue to find BESS to be cost ineffective despite falling costs. This is because battery costs have not fallen enough to make it competitive (Auroville Consulting 2021). Of corporate consumers, 9 out of 101 had previous experience with storage systems; they reported that the adoption of BESS plus RTS systems depends on roof space, battery replacement requirements (every three to four years) and the current cost of BESS systems. SMEs and corporations demand that government agencies formulate policies on battery buyback and recycling. SMEs generally lack the interest and awareness to adopt BESS,

and they find it difficult to get owner approval to install BESS plus RE on leased premises.

Positive sentiments surrounding BESS systems stem from their ability to establish energy independence (which matters more to SMEs) as well as interests in new technologies (such as hydrogen, among corporations). Proof of concept of new technology options may nudge adoption.

Tables 3 and 4 capture the negative and positive sentiments from both consumer segments.

Table 3 | **Negative Sentiments towards BESS**

NEGATIVE SENTIMENT	CORPORATE NON-RE USERS (%, N = 49)	CORPORATE RE USERS (%, N = 52)	SME RE USERS (%, N = 89)	SME NON-RE USERS (%, N = 96)
Storage is currently expensive	14	56	40	18
On-grid systems—no need for batteries	7	45	26	-
Replacement in 3–4 years—added cost	5	34	24	2
Space issue	5	18	12	18
Current technology is not proven and is constrained	2	14	-	-
Disposal concerns—disposal will harm the environment	-	9	3	-
Reliable supply from utilities—no need for batteries	7	9	2	-
Lacking technical know-how	-	7	12	6.3
Generator systems exist—do not need batteries	-	7	-	-
Previous bad experiences—product and service	-	2	1	-
Need buyback policies by state/manufacturer for adoption	-	2	-	-
No active storage policy statement of government	-	2	-	-
Permission required in rented premises and absence of required infrastructure	-	-	-	23

Source: WRI authors.

Table 4 | **Positive Sentiments towards BESS**

POSITIVE SENTIMENT	CORPORATE NON-RE USERS (%, N = 49)	CORPORATE RE USERS (%, N = 52)	SME RE USERS (%, N = 89)	SME NON-RE USERS (%, N = 96)
Corporations are researching and interested	5	14	5	-
Exploring new technology (hydrogen and other systems)	5	7	-	-
Battery systems ensure energy self-sufficiency	-	-	4.5	-

Source: WRI authors.

4.3 Green Tariffs

To better understand C&I consumers' acceptance of the GT in its current form (premium over distribution tariff model), we collected data on their perceptions, acceptability, and WTP. This section analyzes and discusses the results.

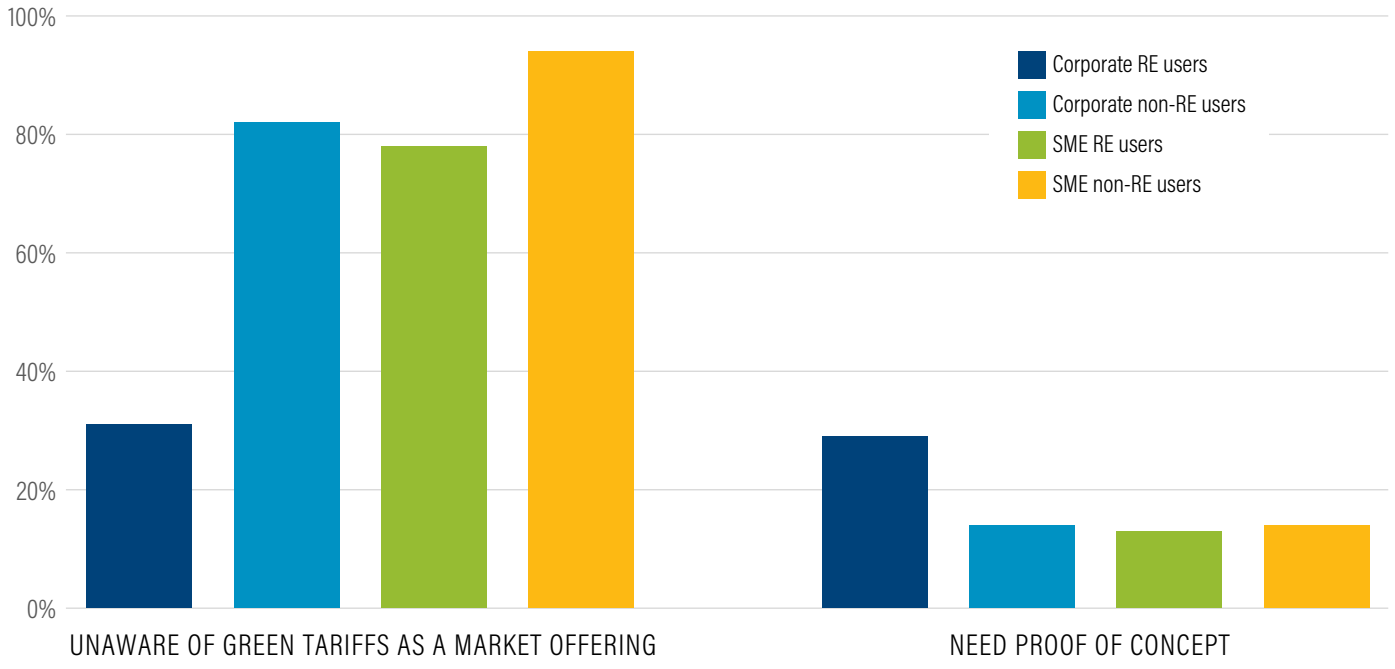
4.3.1 GTs: Awareness, perceptions, and acceptability

We asked C&I consumers questions related to their perceptions, awareness, and acceptability of GTs. The objective was to learn how C&I consumers perceive the idea of a premium-based model for GTs. Text data were collected through in-depth interviews and were subsequently analyzed.

Responses to the questions were primarily categorized into three broad sections: the interested, the opposers, and the undecided. We found an overarchingly negative perception about the current premium-based GT model. Corporate RE adopters were most aware of GTs, keeping abreast of such developments to constantly innovate and meet internal sustainability targets. In the SME sample, however, more than 50 percent of respondents were unaware of GTs, and all segments sought a proof of concept (Figure 5).

About 60–80 percent of the total C&I respondents (n = 286) found GTs to be uneconomical, and a significant proportion preferred to undertake direct investments in renewable assets (Table 5). RTS systems promise better returns on investment comparatively. For large corporations specifically, the initial capital requirement for such systems is not a deterrent RTS, provided that management approves such investments. Negative perceptions about GTs are strongest among existing RE investors (both corporate and SME) who understand the economic complexities of RE procurement routes. Between 5 and 8 percent of the adopters questioned whether the energy supply under GT models would actually come from green sources. Corporate consumers also sought an additionality promise (5.5 percent of the sample) that GT premiums would fund additional RE capacity (Powers and Haddon 2017). The tendency of GT premiums to steadily increase over time is a sticking point for consumers because it impacts a firm's cost economics. Further, between 2 and 5 percent of respondents were concerned about fluctuating REC prices, which make GTs less remunerative.

Figure 5 | **GT Awareness among C&I Consumers**



Notes: RE = renewable energy; SME = small and medium enterprise.
Source: WRI authors.

Table 5 | **GTs: Negative Perceptions**

PERCEPTION	CORPORATE RE (%, N = 52)	SME RE (%, N = 89)	CORPORATE NON-RE (%, N = 49)	SME NON-RE (%, N = 96)
GT is costly in current form	81.8	62.6	63.6	29.2
Prefer installing RE rather than adopting GTs	18.2	13.2	4.5	-
GT does not have return on investment like rooftop solar	9.1	17.6	6.8	-
Adoption only if GT is mandated for C&I consumers	7.3	2.2	2.3	1.0
Uncertain whether supply is actually RE based	5.5	8.8	-	-
Need additionality promise	5.5	-	-	-
Fluctuating REC prices is a concern	3.6	-	-	-
Need clarity on longevity/validity of GTs	3.6	-	-	2.1
GT must be introduced to domestic users	1.8	-	-	1.0
REC benefits need to transfer to the consumer	1.8	-	-	1.0
Need other fiscal incentives to adopt GTs	1.8	2.2	-	-
Good concept, but premium is high	-	9.9	-	-
If GTs come to force, net metering will not be allowed	-	1.1	-	-
Premium will not change, and it will keep increasing	-	1.1	-	-
Adopt only after doing cost-benefit analysis	-	2.2	-	-
Increased cost will not be approved by management	-	1.1	-	-
Adopt only if it is economical to invest in RE	-	3.3	-	-

Notes: C&I = commercial and industrial; GT = green tariff; RE = renewable energy; REC = Renewable Energy Certificate; SME = small and medium enterprise.
Source: WRI authors.

The above analysis shows that the current premium-based GT model is not viewed favorably. GT opt ins will increase only when mandated, and they may suffer lower adoption rates if the mechanism is voluntary. Consumers tend to be "light green" in their actions but carry "dark green" intentions; thus, they view green electricity contracts positively, but the switch from "gray energy" to "green energy" supply contracts is not commensurately high (Litvine and Wüstenhagen 2011). "Green energy defaults" are an effective solution to the consumer inertia in energy contract switching. Green defaults are energy supply contracts that set the green energy supply as the default supply option, and consumers have to make a conscious effort to switch back to gray energy supply options (Pichert and Katsikopoulos 2008). However, green defaults should be introduced cautiously (especially the premium-charging models), because they skew consumer welfare, negatively impacting the poorer consumers more than the wealthier consumers (Ghesla et al. 2020).

The GT is perceived to be a proenvironmental concept, to enable RE procurement without demanding capital investments/commitments, and to offer the REC benefit. This perception resonates among the non-RE adopters (34–38 percent). Of existing RE adopters, 25–29 percent found the concept interesting, and as many as 16–25 percent of the corporate respondents opined that a small GT is acceptable, but they were unable to quantify it. For SMEs, the GT route helps them to adopt green energy without an initial capital investment. Among consumers with small energy demands, the GT is an easy way to procure RE without an equity commitment and is an efficient instrument to meet green energy targets. Table 6 captures the positive sentiments on GTs from all consumer segments included in the study.

Table 6 | **GTs: Positive Perceptions**

PERCEPTION	CORPORATE RE (%, N = 52)	SME RE (%, N = 89)	CORPORATE NON-RE (%, N = 49)	SME NON-RE (5, N = 96)
Good concept—proenvironmental	23.6	9.9	34.1	38.0
Interested despite increased cost	25.5	29.7	31.8	11.5
GTs ensure RE purchase without investing in infrastructure	18.2	5.5	18.2	10.0
GTs are good for consumers who do not already have RE investments and have smaller demands	12.7	4.4	6.8	2.1
Small GT premium is acceptable	16.4	-	25.0	-
GT is profitable when compared to the initial capital investment for RE systems	-	5.5	-	-
Good concept because REC benefit will be good for business	-	1.1	-	-
GT is good for small consumers	-	1.1	-	-
It is an easier way to adopt RE	-	4.4	-	-

Notes: GT = green tariff; RE = renewable energy; REC = Renewable Energy Certificate; SME = small and medium enterprise.
Source: WRI authors.

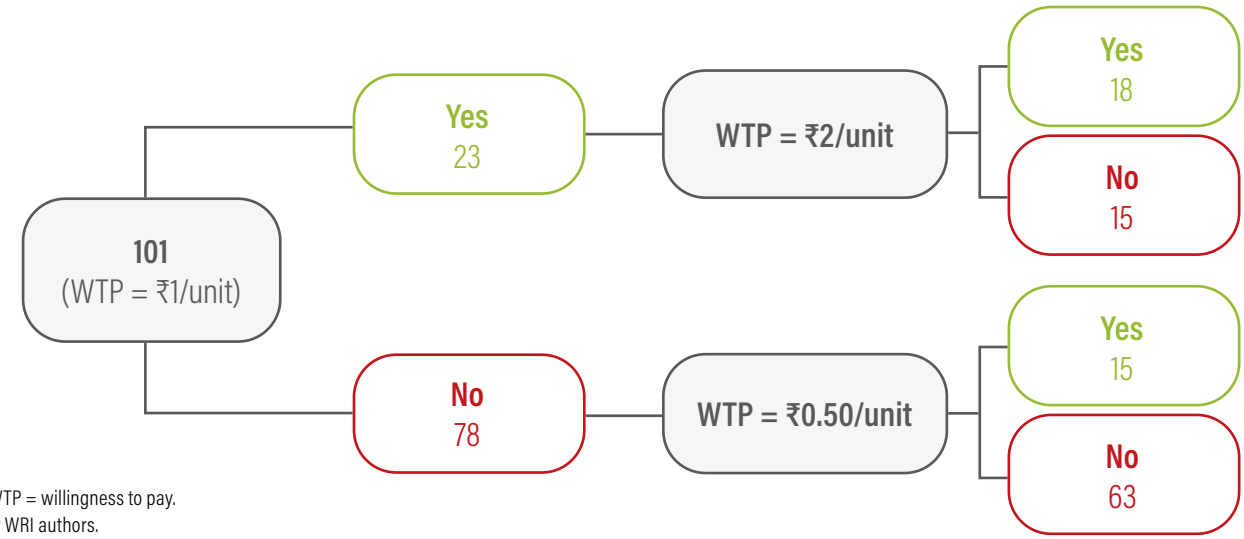
4.3.2 GTs: WTP

Between 11 and 26 percent of the C&I consumers in both segments found GTs acceptable. However, they were unable to quantify their WTP. To get a better sense of their acceptability and WTP for GTs, we conducted a DBDC-CV experiment (see Section 3.1). The DBDC-CV experiment presented GT premium values, which ranged from 3.5 to 15.0 percent of current retail electricity costs (assuming retail costs between ₹11 and ₹13/unit).

Figures 7 and 8 graphically present the results of the DBDC-CV experiment. Responses in both consumer clusters are segmented in four categories: yes-yes, yes-no, no-yes, and no-no). Respondents falling in the first three categories are considered to have a positive WTP (for the bid values presented); however, respondents with a "no-no" response are considered "protestors." Protestors can reveal zero WTP on two accounts: either they truly carry a zero WTP for the good in question or the bid values presented are unable to capture the true WTP (Kriström 1997; Strazzera et al. 2003).

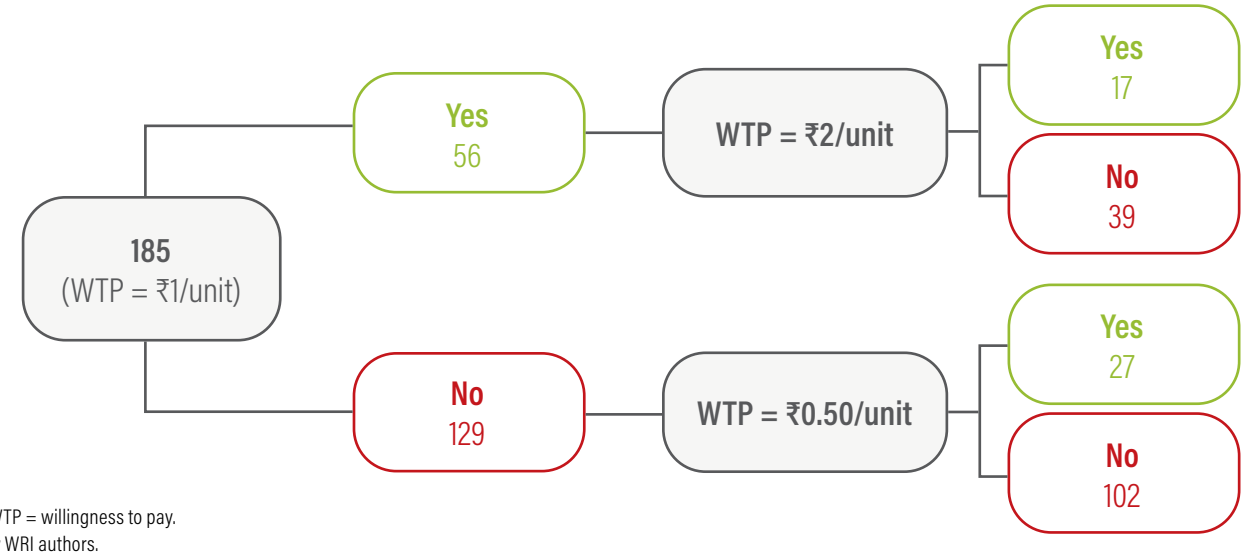
The experiment conducted for this study revealed that, as a concept, GTs are met with a very high share of protest respondents. In our sample, 62.3 percent of the corporations and 55.1 percent of the SMEs turned out to be protest respondents.

Figure 7 | **WTP for GTs: Corporate C&I Consumers**



Note: WTP = willingness to pay.
Source: WRI authors.

Figure 8 | **WTP for GTs: SME C&I Consumers**



Note: WTP = willingness to pay.
Source: WRI authors.

According to the literature, a very high share of protest respondents do not view the product favorably and may desire remodeling (Arrow et al. 1991). To further explore this, we compared GT acceptance in both RE adopters and nonadopters (Table 9) and also looked at the state-wise numbers (Table 10).

We observed that the share of protestors is significantly lower in the nonadopter segment. One reason could be that GTs ensure RE compliance without requiring financial commitments. State-wise numbers suggest a higher share of protestors in Tamil Nadu and Telangana as compared to the other three states.

Table 9 | **GT Acceptance: RE Adopters versus Nonadopters**

	YES-YES	YES-NO	NO-YES	NO-NO	TOTAL
RE users	6 (4%)	20 (14%)	16 (11%)	99 (70%)	**141**
Non-RE users	19 (13%)	34 (23%)	26 (18%)	66 (46%)	**145**

Note: Numbers in parentheses represent row percentage. Totals do not equal 100% due to rounding.
Source: WRI authors.

Table 10 | **WTP for GTs: State-Wise Deep Dives**

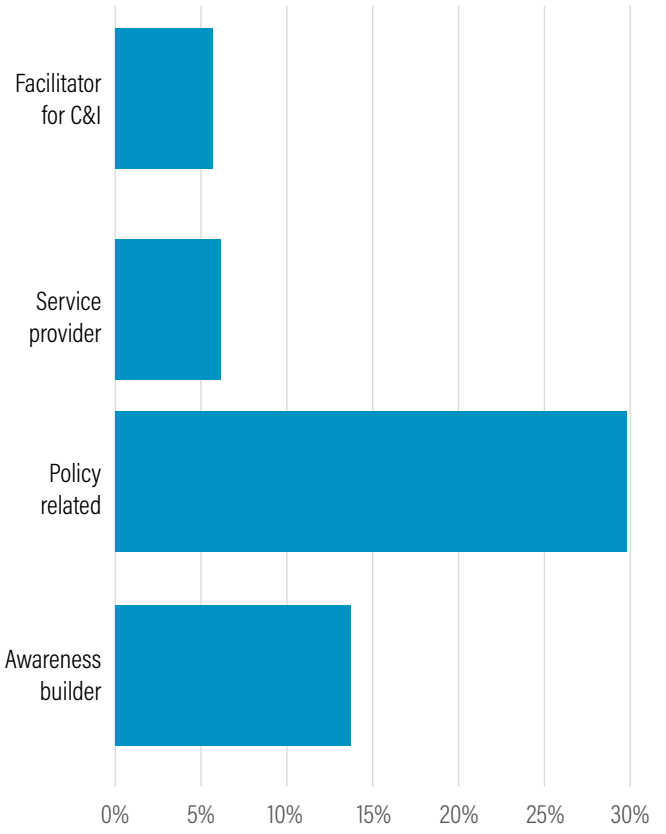
STATE/ REGION	YES-YES	YES-NO	NO-YES	NO-NO	TOTAL
Delhi–NCR	6 (10%)	14 (24%)	5 (9%)	33 (57%)	**58**
Gujarat	6 (11%)	12 (22%)	7 (13%)	30 (55%)	**55**
Kerala	3 (6%)	7 (14%)	10 (20%)	31 (61%)	**51**
Tamil Nadu	4 (6%)	10 (15%)	9 (14%)	42 (65%)	**65**
Telangana	6 (11%)	11 (19%)	11 (19%)	29 (51%)	**57**

Note: NCR = National Capital Region.
Source: WRI authors.

4.4 Expectations from Utilities/DISCOMs

The perception analysis showed that 29 percent of the respondents suggested that DISCOMs provide clarity on RE adoption policies to the end users. Thirteen percent of the sample also suggested that DISCOMs should provide basic information regarding RE benefits and costs, existing government schemes, and subsidies. Figure 9 suggests the top expected roles of DISCOMs, as espoused by the respondents in the survey.

Figure 9 | **Role of DISCOMs as Perceived by the Respondents (Top Responses)**



Notes: C&I = commercial and industrial. Total respondents (n) = 286.
Source: WRI authors.

5. RECOMMENDATIONS

In our study, we observed that both corporate and SME consumers preferred on-site procurement options for RE. We found very low awareness of GTs and an overarchingly negative perception. Consumers desired proof of concept before committing to GTs. Our experiment also revealed that 62 percent of corporate and 55 percent of SME respondents were unwilling to pay the premium values presented. This points to the poor acceptability of current premium-based GT models. Based on these findings, we present four recommendations that aim to introduce easy RE financing avenues for SMEs, help large corporations expand RE portfolios, and increase GT awareness and attractiveness.

5.1 Require Innovative Financing Mechanism for SMEs

SMEs faced major barriers to investing in RE, including a lack of affordable financing and a lack of credit worthiness. SMEs often fail to meet the traditional yardsticks of credit worthiness, which establish their ability to repay loans. As a result, lenders charge them higher interest rates for such loans, making them costly and nonviable. One way to help SMEs establish their repayment ability would be to review their previous year's tax filings and other business revenue records. The Sustainable Partnership for Rooftop Solar Acceleration in Bharat by the State Bank of India and the World Bank, the Solar Rooftop Investment Program by the Punjab National Bank and the Asian Development Bank, and Indian Renewable Energy Development Agency–KfW program could explore these aspects. We recommend introducing such instruments until 2030 for India to become net zero by 2070.

5.2 Explore Virtual PPA and Virtual Net Metering Solutions to Meet 100 Percent of Energy Demand through Renewables for Large Corporations

A key challenge faced by 10 percent of RE corporate adopters is that they are unable to meet 100 percent of their energy demand through RE, even if the organization is keen on doing so. To meet such RE demands, financial/virtual PPAs (possible in India due to the jurisdictional clarity between the Securities and Exchange Board of India and CERC issued in October 2021) can be explored. A financial/virtual PPA is a contract for differences electricity derivative that has proven benefits for both the generator and the consumer (Aggarwal et al. 2019b). The PPA provides electricity price certainty. This would help organizations transition to 100 percent RE until RE plus battery storage becomes more economical.

Additionally, virtual net metering (VNM) can be adopted by those organizations that lease premises and are constrained by issues related to landowner permission for on-site RE systems. With VNM, consumers can be based away from the point of generation yet still claim the benefits of RE. VNM has gained significant success in developed markets (Sasidharan 2018) and with consumers that have RE demand but lack adequate roof space (Dutt and Ranjan 2022). Several models can be devised under VNM, including the one-to-one model or the one-to-many model, carrying attractive energy cost economies for generators and consumers (Sasidharan 2018).

5.3 Increase GT Awareness: Enhanced Role of Utilities as GT Information Champions

We find that GTs suffer from very low awareness, especially among SMEs. Interestingly, SMEs have shown greater interest in adopting GTs because no CAPEX investment is involved during the initial adoption period. To address this awareness challenge, we propose that DISCOMs disseminate information about GT options to opinion leaders. Opinion leadership has played an important role in promoting green consumption (Flynn and Goldsmith 1994). Opinion Leaders are ahead in technology adoption, connected to large social networks, vocal, and exposed to the media (Huang et al. 2020). Therefore, existing C&I RE users who are active on social media and have peer networks can be recognized as opinion leaders by state nodal agencies and can spread information on RE costs, benefits, and procurement strategies based on their good experiences. DISCOMs also need to make consumers aware of GTs. Literature suggests that electricity consumers often suffer from "switching inertia"—consumers do not wish to change from existing power supply arrangements despite other energy supply options. Thus, we recommend that DISCOMs include information about GTs and switching methods in the electricity bills for all eligible consumers, easily increasing awareness. Through GTs, C&I consumers can meet RE targets without capital commitments, and DISCOMs can keep their high-paying consumers from migrating to self-generation. This can work in SME clusters that have shown higher interest in GTs.

5.4 Increase GT Attractiveness: Offer a GT Demand Aggregator Model

One of the main GT barriers is that C&I consumers have to pay over and above their existing tariff. To avoid such a situation, we propose a GT demand aggregator model. Under this model, consumers' energy demand is aggregated by the utility. Utilities lock the high-paying C&I consumers into their service areas and provide RE. C&I consumers get RE without any capital investment, and utilities minimize the transmission and distribution loss and cost differential between generation and retail tariff.

Aggregated demand could be met through RE upon payment of the GT. The GT could be fixed at a mutually acceptable rate between consumers and DISCOMs. The premium collected could be used by DISCOMs to set up additional RE capacities such as RTS, and it should not be treated as nontariff income. For this, idle roof capacities that are currently unused by SMEs could be used by DISCOMs.

A similar practice is offered in developed markets, with a "default opt-in" status for the consumers, under the community choice aggregation model (EPA 2018).

The main thrust should be to create an enabling environment for RE procurement and adoption. New procurement methods, such as GTs, could enhance consumer adoption and help DISCOMs retain high-paying C&I consumers. Without better-performing DISCOMs and active participation of C&I consumers in procuring more RE, India might not achieve its 500 GW goal by 2030.

APPENDIX A: SURVEY QUESTIONNAIRE FOR RE ADOPTION AMONG C&I CONSUMERS

The purpose of this survey is to understand the current levels of RE penetration among C&I consumers, the existing energy mix, and the levels of dependence on the local DISCOM for electricity supply.

Section 1: Common Questions

<table>
<tr><td>State</td><td></td></tr>
<tr><td>Name of the company/ proprietorship</td><td></td></tr>
<tr><td>Contact person and designation</td><td></td></tr>
<tr><td>Address</td><td></td></tr>
<tr><td>Type of industry
(Manufacturing, information technology, commercial consumer)</td><td></td></tr>
<tr><td>Annual turnover of organization (approximate)
(This will help us categorize them into micro, small, or medium as per government definition)</td><td></td></tr>
<tr><td>Type of electricity connection or voltage supply
(Commercial/industrial and high tension/low tension)</td><td></td></tr>
<tr><td>Total connected load (kW)</td><td></td></tr>
<tr><td>Total electricity consumption (monthly in approximate numbers)
(Before and after COVID-19 lockdown)</td><td></td></tr>
<tr><td>Cost of electricity consumption/month
(Indian rupees, as per monthly e-bills)</td><td></td></tr>
<tr><td>Tariff rate as per electricity bill (per unit cost)</td><td></td></tr>
<tr><td colspan="2">Does your organization currently engage in use of RE in any way?

☐ Yes
☐ No</td></tr>
<tr><td colspan="2">Questions only for adopters</td></tr>
<tr><td>Type of RE system
(Wind through OA, solar through OA, rooftop solar, small hydro, biomass, waste to energy)</td><td></td></tr>
<tr><td>Capacity contracted/installed</td><td></td></tr>
<tr><td>Installation year (if multiple, please mention all)</td><td></td></tr>
<tr><td>Financial model for RE system adopted</td><td>
<table>
<tr><th>RE system/ financial model</th><th>Self-financed equity</th><th>RESCO</th><th>CAPEX</th><th>Loan from bank/financial institution</th></tr>
<tr><td>Wind—OA</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Solar—OA</td><td></td><td></td><td></td><td></td></tr>
<tr><td>RTS</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Small hydro</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Biomass</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Waste to energy</td><td></td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Energy generated from RE monthly in approximate numbers (kWh/units)</td><td></td></tr>
</table>

Section 2A: Questionnaire for RE Adopters

For adopters:

1. What factors influenced your decision to adopt RE?
2. Can you elaborate on the process followed for deciding about the above? Probe: This can include details of CAPEX versus RESCO, organizational discussions to take the RE investment decision, time taken for the projects, other cost considerations, and so forth.
3. How did you decide on the financial model for your project?
4. As an RE user, are you facing any problems with your RE project? If yes, can you please elaborate?
5. Are there other C&I consumers in your network using RE? Can you elaborate? Probe: Details of the investor? Which RE system? Method of adoption/ business model?
6. How can the adoption of RE be increased for other consumers of electricity?
7. Have you adopted any battery storage systems for storing RE power generated?

☐ Yes

☐ No

If yes, probe: What kind of battery system is in place? At what costs? How much energy have you been able to store?

If no, ask Question 8.

8. Are you aware of the upcoming battery storage solutions for RE?

☐ Yes

☐ No

Probe: Battery systems use lithium-ion technology. The costs of a solar-plus-battery storage system can increase the cost of RE systems by 30 percent. But with a storage system, any surplus RE generation can be stored for later use.

8a. If yes, do you plan to adopt battery storage in the future?

☐ Yes

☐ No

8b. If no, what are the key deterrents to battery adoption? (*Interviewers should ask the respondents to rank the options that are key deterrents for them. If option "other" is mentioned by respondents as the key deterrent, it should be ranked as the number-one deterrent.)*

	Rank 1	Rank 2	Rank 3	Rank 4
Financial constraints—lack of capital available within the organization				
Financial constraints—lack of access to cheap loan/capital				
Lack of technical awareness				
Lack of on-site space				

Any other _____

9. Do you know of GTs offered in some states, such as Karnataka and Maharashtra, as a route for adopting RE? If yes, can you please elaborate? Probe: Are they optional or mandatory; who offers them; and what are the qualification criteria, approval mechanism, and pros and cons?

Comment: At this point, an information sheet on GTs is to be shown to the respondent. The information sheet should describe what a GT is, how it works, and the price at which it is being offered in Karnataka and Maharashtra. The information sheet should also communicate that the GT will come at a premium over the existing distribution tariff that the C&I consumer is already paying.

10. After listening to the description of the GT we just explained to you, how interested are you in this GT? Please select the most appropriate response, on a scale of 1–5 depicted below:

1 ⟷ **5**

Not at all interested — Extremely interested

11. You are currently paying between ₹7 and ₹11 per unit for electricity. If you were to adopt a green PPA, would you be willing to pay a GT premium of **₹1/unit/month**? Remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

☐ No

Probe: If the answer to Question 11 is yes, then ask Question 12; otherwise, ask Question 13.

12. Would you be willing to pay an increased premium of **₹2/unit/month**? Again, please remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

☐ No

13. Would you be willing to pay a reduced premium of **₹0.50/unit/month**? Again, please remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

☐ No

14. In your opinion, what are some of the changes that utilities/DISCOMs need to make to encourage RE adoption? Probe: This question should reveal what changes DISCOMs need to make for faster RE adoption.
15. Are you satisfied by the products offered by the utility/DISCOM? Please rate them on a scale of 1–5, with 1 being not satisfied at all and 5 being very satisfied.

☐ 1

☐ 2

☐ 3

☐ 4

☐ 5

16. What kind of green products do you expect from the utilities in the future? Probe: C&I consumers may mention what green/RE options they are most comfortable with, over and above what already exists (such as OA captive, OA third-party, RTS, and GT options).
17. In your opinion, which green product mentioned above would increase RE adoption the fastest?

Section 2B: Questionnaire for RE Nonadopters

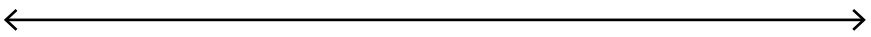
For nonadopters:

1. Have you ever been approached by someone about adopting an RE system?
2. What are your reasons for not adopting RE resources?
3. Does your organization intend to adopt RE in the near future?
   - 3a. If yes, which kind of system will you prefer? Probe: What kind of system (stand-alone with storage, stand-alone no storage, grid connected, etc.)?
   - 3b. If no, can you elaborate on the reason for not adopting RE?
4. Are there other C&I consumers in your network using RE? Can you elaborate? Probe: Details of the investor? Which RE system? Method of adoption/business model?
   - 4a. If yes, do you know what motivated them to adopt the RE system?

5. How can the adoption of renewable energy be increased for other consumers of electricity?
6. Do you know of GTs offered in some states, such as Karnataka and Maharashtra, as a route for adopting RE? If yes, can you please elaborate? Probe: Are they optional or mandatory; who offers them; and what are the qualification criteria, approval mechanism, pros and cons, and so forth?

Comment: At this point, an information sheet on GTs is to be shown to the respondent. The information sheet should describe what a GT is, how it works, and the price at which it is being offered in Karnataka and Maharashtra. The information sheet should also communicate that the GT will come at a premium over the existing distribution tariff that the C&I consumer is already paying.

7. After listening to the description of the GT we just explained to you, how interested are you in this GT? Please select the most appropriate response, on a scale of 1–5 depicted below:



Not at all interested — Extremely interested

8. You are currently paying between ₹7 and ₹11 per unit of electricity. If you were to adopt a green PPA, would you be willing be to pay a GT premium of **₹1/unit/month**? Remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

☐ No

Probe: If the answer to Question 9 is yes, then ask Question 10; otherwise, ask Question 11.

9. Will you be willing to pay an increased premium of **₹2/unit/month**? Again, please remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

☐ No

10. Will you be willing to pay a reduced premium of **₹0.50/unit/month**? Again, please remember, this premium is charged per unit of energy consumed over and above existing per-unit costs and will be a permanent charge on your bills.

☐ Yes

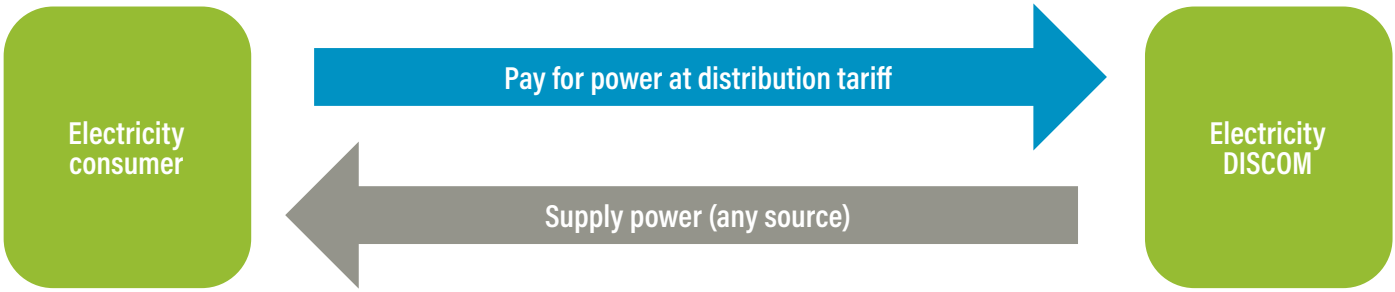
☐ No

11. In your opinion, what are some of the changes that utilities/DISCOMs need to make to encourage RE adoption? Probe: This question should reveal what changes DISCOMs need to make for faster RE adoption.
12. What kind of green products do you expect from the utilities in the future? Probe: C&I consumers may mention what green/RE options they are most comfortable with, over and above what already exists (such as OA captive, OA third-party, RTS, and GT options).
13. In your opinion, which green product mentioned above can increase RE adoption the fastest?

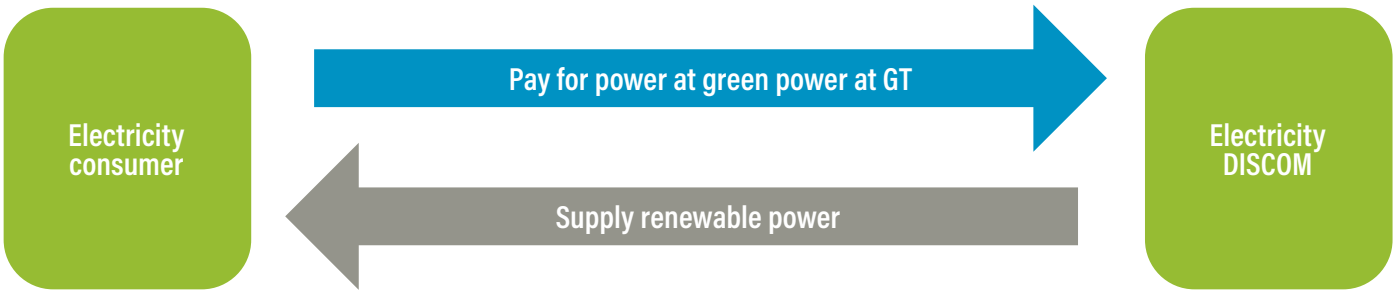
APPENDIX B: C&I CONSUMER RE ADOPTION SURVEY: INFORMATION SHEET

The new GT mechanism was introduced to allow electricity consumers to procure RE. To better understand the mechanism, please refer to the following infographics.

Existing Electricity Consumption Model



The GT Electricity Consumption Model



By opting for the GT, consumers are promised 100 percent green power, supplied from RE sources (such as wind, solar, etc). However, to avail the GT, **the consumer has to pay a premium, over and above the existing applicable distribution tariff**.

Advantages of GTs

Consumers can meet RE requirements without making capital investments; many big companies are procuring RE themselves and, at times, are requiring that their suppliers also procure RE.

The GT in Various States in India

Karnataka

₹0.50 over and above applicable tariff/unit for high-tension C&I consumers

Maharashtra

₹0.66 over above applicable tariff/unit for all consumers

ABBREVIATIONS

AS	additional surcharge
BESS	battery-enabled storage solution
C&I	commercial and industrial
CAPEX	capital expenditures
CERC	Central Electricity Regulatory Commission
CPP	captive power plant
CSS	cross subsidy surcharge
DBDC-CV	double-bounded dichotomous choice contingent valuation
DISCOM	distribution company
GT	green tariff
HT	high tension
JNNSM	Jawaharlal Nehru National Solar Mission
LT	low tension
MoP	Ministry of Power
NCR	National Capital Region
NLDC	national load dispatch center
OA	open access
PPA	power purchase agreement
RE	renewable energy
REC	renewable energy certificate
RESCO	renewable energy service company
RPO	renewable purchase obligation
RTS	rooftop solar
SME	small and medium enterprise
VNM	virtual net metering
WTP	willingness to pay

ENDNOTES

1. *Additionality* refers to the RE capacity added due to the C&I consumer opting in for GTs. Quantitatively, it is the RE capacity that would not have been added otherwise (Powers and Haddon 2017).
2. This is the amount of capital support for RE projects provided by the central government through the Ministry of New and Renewable Energy.
3. This is a type of support for infrastructure projects that are economically justifiable but financially not viable. The central government provides this support to make up the costs incurred for the projects.
4. These are generation-linked monetary incentives given primarily to wind and solar generators to make their investment in this sector attractive.
5. These are mandatory purchase obligations imposed on DISCOMs and commercial and industrial consumers to meet a percentage of their electricity demand from RE resources to create RE demand.
6. This is an agreement between two entities in which one generates power and the other buys power for consumption.
7. This is a mechanism that allows domestic or commercial users who generate their own electricity using solar panels or photovoltaic systems to export their surplus energy back to the grid. In general, the RTS capacity in India is limited to 1 MW, with the compensation for surplus injection under net metering to ₹2–₹4 per unit (depending on the state).
8. This is an arrangement in which the consumer is compensated at a fixed amount of tariff, which is predetermined by the DISCOM, on the amount of RE units exported to the grid.
9. This is the surcharge payable by the consumers opting for OA on the network of the distribution licensee (DISCOM) or transmission licensee. The surcharge value is generally 20 percent of the average billing rate of said high-tension consumer segment and is around ₹1.4–₹2.0/unit, based on the states considered for this research analysis.
10. In recent years, DISCOMs have been witnessing surplus baseload capacity. In many states, electricity regulatory commissions have introduced an additional surcharge on OA consumers to compensate the DISCOMs for capacity that is underutilized due to fall in demand, which is attributable to loss of sales via OA. The National Tariff Policy 2016 allows for the recovery of such an additional surcharge only if it is conclusively proved that there is an unavoidable burden on the DISCOM to bear the fixed costs of capacity that is now stranded but was contracted earlier to meet its supply obligation.
11. C&I RE installed capacity accounts for 16 percent of the nation's installed RE capacity (104.8 GW; CEA 2021b).
12. The average billing rate is obtained from tariff orders and OA charges order based on the states considered in the survey. This applies to consumers connected on high tension (HT) connectivity.
13. For details, see the Maharashtra Electricity Regulatory Commission Order in Case No. 134 of 2020.
14. RE adopters are C&I consumers who have either on-site RE capacities or have contracted through off-site OA arrangements.
15. RE nonadopters are C&I consumers who have yet to procure RE from any of the procurement methods available.
16. Corporate consumers are C&I consumers with investments of more than ₹10 crores in business plant and machinery (and other capital expenditures).
17. SMEs are C&I consumers with investments in plant and machinery ranging from ₹25 lakhs to ₹10 crore, as defined by the Ministry of Micro, Small and Medium Enterprises.
18. In purposive sampling, study participants are recruited based on their willingness to provide information on research questions, based on their experience and knowledge (Alkassim and Tran 2016).
19. Hedonic value refers to the impact of internal and external factors that affect the price of a good (real estate property in this case). An RTS system is an internal factor that can diminish the property's market value. Gaur (2021) reports that U.S. consumers are willing to pay in order to hide the view of RTS systems.

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ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

Our Challenge

Natural resources are at the foundation of economic opportunity and human well-being. But today, we are depleting Earth's resources at rates that are not sustainable, endangering economies and people's lives. People depend on clean water, fertile land, healthy forests, and a stable climate. Livable cities and clean energy are essential for a sustainable planet. We must address these urgent, global challenges this decade.

Our Vision

We envision an equitable and prosperous planet driven by the wise management of natural resources. We aspire to create a world where the actions of government, business, and communities combine to eliminate poverty and sustain the natural environment for all people.

Our Approach

COUNT IT

We start with data. We conduct independent research and draw on the latest technology to develop new insights and recommendations. Our rigorous analysis identifies risks, unveils opportunities, and informs smart strategies. We focus our efforts on influential and emerging economies where the future of sustainability will be determined.

CHANGE IT

We use our research to influence government policies, business strategies, and civil society action. We test projects with communities, companies, and government agencies to build a strong evidence base. Then, we work with partners to deliver change on the ground that alleviates poverty and strengthens society. We hold ourselves accountable to ensure our outcomes will be bold and enduring.

SCALE IT

We don't think small. Once tested, we work with partners to adopt and expand our efforts regionally and globally. We engage with decision-makers to carry out our ideas and elevate our impact. We measure success through government and business actions that improve people's lives and sustain a healthy environment.