

Performance of home solar plant installation companies in India with special reference to Kerala: A decade-long review (2016–2026)

Dr. Dean Martin C

Associate Professor, Research Guide & HOD, Department of Commerce, Govt Arts & Science College Ollur, Thrissur,
Kerala, India

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Abstract

This research article examines the performance of home solar plant installation companies in India, with a focused analysis of Kerala's unique rooftop solar ecosystem over the past decade (2016–2026). Kerala has emerged as a frontrunner in residential solar adoption, driven by progressive policies, high electricity tariffs, and strong consumer awareness. The state's total installed solar capacity has reached 2,233.79 MW, with the residential sector accounting for the dominant share. The PM Surya Ghar Muft Bijli Yojana has catalyzed remarkable growth, with over 2,84,090 households completing installations and more than ₹2,000 crore in subsidies disbursed. However, this success has created structural challenges: Kerala's evening-peak demand profile means only 36% of solar generation is consumed during daylight hours, while the remaining 64% is exported to the grid, imposing significant financial stress on Kerala State Electricity Board (KSEB) exceeding ₹500 crore annually. The study analyzes company-level performance, policy impacts, regulatory challenges, and quality assurance mechanisms, providing insights for stakeholders navigating Kerala's rapidly evolving residential solar market.

Keywords: Rooftop Solar, Kerala solar market, PM Surya Ghar Yojana, solar installation companies, KSEB, net metering, ANERT, solar EPC

Introduction

Kerala presents a compelling case study in India's solar energy transition. Despite its high population density, limited land availability, and geographic constraints, the state has emerged as one of India's leading adopters of rooftop solar. With renewable energy accounting for 54.6% of its installed capacity—one of the highest proportions in the country—Kerala has demonstrated that a well-designed policy framework can overcome structural limitations.

The state's rooftop solar journey began early, with the Kerala State Electricity Regulatory Commission (KSERC) establishing regulations for power procurement from solar PV plants as early as 2008. The launch of ANERT's "10,000 Roof Top Solar PV" scheme in 2011-12, which provided 50% subsidy for 1 kW systems with battery backup, created the foundation for widespread adoption. This program won national recognition and established a template for consumer-centric solar promotion.

The past decade (2016–2026) has witnessed transformative growth, particularly following the launch of the PM Surya Ghar: Muft Bijli Yojana in 2024. Kerala has seen over four lakh applications, 2,84,090 completed household installations, and more than ₹2,000 crore in central subsidies disbursed. The state now hosts 1,525 authorised solar vendors, creating a competitive and diverse installation ecosystem.

However, this rapid expansion has exposed significant structural challenges. Kerala's electricity demand profile is heavily skewed toward evening hours, with peak demand occurring between 6 PM and 12 AM—a time when solar generation is zero. This mismatch has created financial stress for KSEB, with solar banking imbalances reportedly causing losses exceeding ₹500 crore in 2024-25 alone. Regulatory responses, including the draft Renewable Energy and Related Matters Regulations 2025 that restrict net

metering to capacities under 3 kW, have raised concerns about the future trajectory of rooftop solar growth.

This research addresses a critical gap in the literature: while Kerala's aggregate solar adoption data is well-documented, systematic analysis of company-level performance, competitive dynamics, and the operational challenges faced by installation companies remains limited. The study aims to provide a comprehensive assessment of home solar plant installation companies in Kerala, examining their performance, the policy environment in which they operate, and the emerging challenges that will shape the sector's future.

Scope of the Study

Geographic Coverage: Pan-Kerala analysis with district-level disaggregation for key markets (Ernakulam, Thrissur, Thiruvananthapuram, Kollam, Alappuzha, Malappuram, Kannur, Kozhikode, Kottayam, Palakkad, Pathanamthitta, Kasaragod, Idukki, Wayanad).

Temporal Coverage: Financial years 2016–2026, with particular emphasis on the post-2024 PM Surya Ghar period and the draft KSERC Renewable Energy Regulations 2025.

Company Coverage

- **National Players with Kerala Presence:** Tata Power Solar, Waaree Energies, Vikram Solar, Adani Solar
- **Kerala-Based Organised Players:** INKEL Limited (Government-accredited, SP1B-rated, "Best EPC Contractor of the Year 2022" by Solar Quarter)
- **Kerala-Based Specialists:** Galian Watts (founded 2018), Illumine Energy Solutions (5,000+ projects), Aeco Solar (Alternative Energy Corporation), Sun

World Solar Systems, Solstrom Solar Energy, Green Power Solutions

- **ANERT-Approved Vendors:** Companies registered and rated under ANERT's vendor certification program

Performance Dimensions

- Installation volumes and capacity added
- Geographic distribution and market share
- Vendor certification and quality ratings
- Subsidy facilitation and DISCOM coordination
- After-sales service and consumer satisfaction
- Regulatory compliance and adaptation capacity

Policy and Regulatory Analysis

- PM Surya Ghar Muft Bijli Yojana implementation in Kerala
- KSERC Renewable Energy Regulations (2020 and draft 2025)
- ANERT programs (10,000 Roof Top Solar PV, Souraveedhi App, Akshaya Urja Service Centres)
- KSEB net metering and fee waiver policies

Research Problem- Primary Research Question: How have home solar plant installation companies in Kerala performed over the past decade, and what factors explain performance variations across companies, districts, and consumer segments?

Sub-Questions

1. What has been the trajectory of rooftop solar adoption in Kerala, and how does it compare to national trends?
2. Which installation companies have emerged as market leaders in Kerala, and what operational and financial characteristics distinguish top performers?
3. How has the PM Surya Ghar Yojana influenced company performance, market structure, and consumer adoption patterns in Kerala?
4. What structural challenges—particularly regarding grid integration and regulatory changes—affect company operations and consumer economics?
5. What role do state-level institutions (ANERT, KSEB, KSERC) play in shaping the competitive environment for installation companies?

Research Hypotheses

- **H1:** Kerala's early mover advantage in rooftop solar has created a mature, competitive installation ecosystem, with over 1,500 registered vendors and significant variation in company quality and performance.
- **H2:** The PM Surya Ghar scheme has dramatically accelerated residential adoption, with organized players achieving disproportionate growth in installation volumes and revenue.
- **H3:** Company performance varies significantly across Kerala's districts, with Ernakulam, Thrissur, and Thiruvananthapuram representing the largest and most competitive markets.
- **H4:** Regulatory changes restricting net metering and introducing net billing will significantly impact company business models and consumer demand.

- **H5:** Structural challenges—particularly the mismatch between solar generation and Kerala's evening-peak demand—will drive industry consolidation and demand for battery storage solutions.

Limitations of the Study

1. **Data Availability Constraints:** Comprehensive, standardized performance data for all 1,525 registered installation vendors is unavailable. The analysis necessarily focuses on companies with publicly available information.
2. **Self-Reported Metrics:** Company-reported installation figures and ratings may be subject to varying verification standards. Independent validation is limited.
3. **Regulatory Uncertainty:** The KSERC draft regulations are under stakeholder consultation; their final form and impact remain uncertain.
4. **Quality Metrics:** Objective measurement of installation quality is challenging due to the absence of standardized, publicly available quality audit data. UPNEDA-style vendor rating systems are not yet fully implemented in Kerala.
5. **Consumer Satisfaction:** Systematic consumer satisfaction data across installation companies is limited, affecting the ability to assess after-sales service quality comprehensively.
6. **Financial Performance:** Many Kerala-based installation companies are privately held, limiting access to financial performance data.

Research Methodology

Research Design: Mixed-methods approach combining quantitative analysis of secondary data and qualitative assessment of policy documents, company reports, and industry analyses.

Data Sources

Primary Sources

- KSEB data obtained through RTI (as reported in ETV Bharat)
- Company websites and LinkedIn profiles
- ANERT program documents and interviews
- KSERC regulatory documents

Secondary Sources

- Industry reports (JSTOR, Down To Earth, Swarajyamag)
- Financial databases and company rankings
- Trade publications and news reports (ET EnergyWorld)
- Academic and policy research

Data Collection Period: Systematic collection of publicly available data for the period 2016–2026, with quarterly and annual granularity where available.

Analytical Framework

Quantitative Analysis

- Descriptive statistics and trend analysis of installation capacities, district-wise distribution, and vendor counts

- Market share calculations and concentration analysis
- Year-over-year growth rate computations

Qualitative Analysis

- Thematic analysis of policy documents and regulatory changes
- Comparative case analysis of leading companies
- Stakeholder impact assessment

Performance Indicators

- Installation volumes (household counts and capacity)
- Geographic distribution (district-level)
- Vendor certification and rating status
- Subsidy processing efficiency
- Company reputation and consumer reviews
- Adaptability to regulatory changes

Review of Literature

1. Kerala's Early Mover Advantage in Rooftop Solar

Kerala's journey in rooftop solar adoption stands as a model for other Indian states. The state's total share of renewable energy—54.6% of installed capacity—is one of the highest in the country. This achievement is rooted in progressive policy-making that began with KSERC's 2008 regulations on power procurement from solar PV plants. The ANERT-led "10,000 Roof Top Solar PV" scheme (2011-12) marked a watershed moment, providing 50% subsidy for 1 kW systems with battery backup and achieving a failure rate of less than 1%. This program, which won national recognition from the Association of Renewable Energy Agencies of States (AREAS), established Kerala as a pioneer in government-led rooftop solar promotion.

2. Policy Evolution and Institutional Framework

The institutional architecture for rooftop solar in Kerala is anchored by three key institutions: ANERT (the State Nodal Agency for MNRE), KSEB (the distribution licensee), and KSERC (the regulatory commission). ANERT's innovative approach includes distributing subsidy through the 3-tier Local Self Governments (LSGs), enabling beneficiary selection at the grassroots level. The organization has also developed the Souraveedhi App for system registration and insurance, and is establishing Akshaya Urja Service Centres in all 140 assembly constituencies to address after-sales service gaps.

3. PM Surya Ghar Scheme Implementation in Kerala

The PM Surya Ghar Muft Bijli Yojana has transformed Kerala's residential solar landscape. As of August 2026, over four lakh applications have been received, with 2,84,090 households completing installations and 2,67,410 beneficiaries receiving central subsidies amounting to over ₹2,000 crore. The subsidy structure provides ₹30,000 for 1 kW, ₹60,000 for 2 kW, and up to ₹78,000 for systems of 3 kW or more. KSEB has further supported adoption by waiving application and registration fees following Union government directives.

4. Company Performance and Competitive Dynamics

Kerala's solar installation market hosts 1,525 authorised vendors, creating a highly competitive environment. National players like Tata Power Solar, Waaree Energies, and Vikram Solar have established a presence, while Kerala-based companies have developed specialized

expertise. INKEL Limited, a government-accredited agency, has achieved the highest SP1B rating for Solar System Integrators and has executed cumulative projects exceeding 15 MWp, winning the "Best EPC Contractor of the Year 2022" award.

Companies like Galian Watts, founded in 2018, exemplify the growth of Kerala-based specialists, offering on-grid, off-grid, and hybrid solutions across Ernakulam, Thrissur, and other districts. Illumine Energy Solutions has completed over 5,000 projects with 4.7+ ratings, while Sun World Solar Systems maintains a 4.9/5 customer rating. These companies differentiate through local expertise, particularly in handling Kerala's monsoon conditions, KSEB net-metering coordination, and subsidy facilitation.

5. Structural Challenges: Grid Integration and Financial Stress

Kerala's rooftop solar success has created an unintended consequence: significant financial stress on KSEB. The state's electricity demand profile is heavily skewed toward evening and night, with peak demand occurring between 6 PM and 12 AM. Only 36% of rooftop solar generation is consumed during daylight hours; the remaining 64% is exported to the grid, and nearly 45% of that exported energy is later drawn back by the same consumers at night under net metering and solar banking arrangements. This creates a fundamental imbalance: KSEB credits prosumers for midday solar power that does little to reduce peak demand, while still purchasing expensive power in the evening.

The financial consequences are substantial. KSEB spends over 60% of its total turnover on power purchases, amounting to roughly ₹13,000 crore annually. In 2024-25 alone, solar banking imbalance reportedly resulted in losses exceeding ₹500 crore, translating into an estimated 19 paise per unit increase in electricity bills for all consumers.

6. Regulatory Responses and Uncertainties

In response to these challenges, KSERC released a draft regulation titled "Renewable Energy and Related Matters, 2025". Key provisions include:

- Restricting net metering to capacities under 3 kW (from the previously permissible 1 MW limit)
- Introducing net-billing for consumers under 500 kW limit
- Levying cross-subsidy charges and electricity duty
- Applying feed-in tariff rates at SECI-discovered prices (₹2-2.5/kWh) compared to current tariffs of ₹3.59-3.26/kWh

These provisions are widely seen as potentially impeding rooftop solar growth and raising consumer costs. The shift from net metering (where exported power receives retail tariff credit) to net billing (where exported power receives lower feed-in tariff) reduces the financial attractiveness of rooftop solar for new consumers.

7. Consumer Economics and Adoption Drivers

The economic case for rooftop solar in Kerala is compelling. A typical 3 kW solar system costs ₹1.80-2.30 lakh; after the ₹78,000 subsidy, the effective cost drops to ₹1.02-1.52 lakh. With Kerala's high electricity tariffs, most homes achieve payback within 4-5 year. KSEB pays ₹3.26 per unit for surplus electricity exported to the grid, providing additional income for prosumers.

Analysis

1. Kerala's Rooftop Solar Growth Trajectory

Table 1: Key Indicators of Kerala's Rooftop Solar Market (2026)

Indicator	Value
Total Installed Solar Capacity	2,233.79 MW
Household Installations Completed	2,84,090
Total Applications Received	4,00,000+
Beneficiaries Receiving Subsidy	2,67,410
Total Subsidy Disbursed	₹2,000+ crore
Authorised Solar Vendors	1,525
KSEB Surplus Electricity Rate	₹3.26/unit
Average Subsidy Disbursement Time	~30 days

Sources: ETV Bharat, Solar Times

Fig 1: District-Wise Distribution of Rooftop Solar Installations

District	Applications	Completed Installations
Ernakulam	70,345	48,072
Thrissur	48,335	34,144
Thiruvananthapuram	43,997	30,056
Kollam	39,143	25,654
Alappuzha	37,721	24,914
Malappuram	32,837	22,527
Kannur	28,070	19,982
Kozhikode	28,842	18,979
Kottayam	25,890	17,801
Palakkad	24,907	17,754
Pathanamthitta	14,736	10,198
Kasaragod	12,654	9,031
Idukki	5,158	3,303
Wayanad	2,722	1,675
Total	4,00,000+	2,84,090

Source: KSEB data via RTI

2. Company Performance Analysis

Table 2: Leading Solar Installation Companies in Kerala

Company	Type	Key Strengths	Rating/Recognition
Tata Power Solar	National	Trusted brand, robust service network	Market leader
INKEL Limited	Kerala-based, Govt-accredited	SP1B rating, "Best EPC Contractor 2022"	Highest government rating
Illumine Energy Solutions	Kerala-based (Edappally)	5,000+ projects, 4.7+ rating	High customer satisfaction
Sun World Solar Systems	Kerala-based	4.9/5 rating	Top residential installer
Galian Watts	Kerala-based (founded 2018)	Tier-1 components, premium tech (Enphase)	Recognized specialist
Aeco Solar	Kerala-based (Kochi)	MNRE-empaneled, monsoon-resistant	Leading Kochi installer
Waaree Energies	National	Durable panels for coastal humidity	Brand recognition

Sources: Company profiles and rankings

3. PM Surya Ghar Scheme Impact Analysis

Table 3: Subsidy Structure Under PM Surya Ghar

System Capacity	Subsidy Amount	Typical System Cost (Pre-subsidy)	Effective Cost
1 kW	₹30,000	₹75,000 – ₹85,000	₹45,000 – ₹55,000
2 kW	₹60,000	₹1,50,000 – ₹1,70,000	₹90,000 – ₹1,10,000
3 kW	₹78,000	₹1,90,000 – ₹2,20,000	₹1,12,000 – ₹1,42,000
5 kW	₹78,000 (max)	₹3,00,000 – ₹3,50,000	₹2,22,000 – ₹2,72,000

Sources: Solar Times, Aeco Solar

4. Structural Challenges Analysis

Fig 2: Kerala's Solar Generation vs. Demand Mismatch

Metric	Value
Solar Generation Consumed During Daylight Hours	36%
Solar Generation Exported to Grid	64%

Exported Energy Re-drawn at Night	~45%
KSEB Power Purchase Expenditure	~₹13,000 crore/year
Solar Banking Imbalance Losses (2024-25)	₹500+ crore
Estimated Tariff Burden (Current)	19 paise/unit
Projected Tariff Burden (2034-35)	39 paise/unit

Source: Swarajyamag analysis

5. Regulatory Impact Assessment

Table 4: Comparison of Metering Arrangements

Aspect	Net Metering (Current)	Net Billing (Proposed)	Gross Metering
Export Tariff	Retail tariff rate (~₹3.26/kWh)	SECI feed-in tariff (₹2-2.5/kWh)	Low feed-in tariff
Consumer Benefit	Highest financial return	Reduced return	Lowest return
Applicable Capacity	Up to 3 kW (draft)	Up to 500 kW	Up to 3 MW
Utility Impact	Maximum losses	Reduced losses	Minimal losses

Source: Down To Earth analysis

6. Vendor Quality Analysis

Table 5: ANERT's Quality Assurance Initiatives

Initiative	Description	Status
Akshaya Urja Service Centres	Repair/service centres in 140 constituencies	1,565 applications received
Souraveedhi App	System registration + 1-year free insurance	Live
ANERT-Approved Vendors	Certified installation companies	Active
LSG Subsidy Distribution	Subsidy through 3-tier Local Self Governments	Active

Results and Discussions

1. Key Findings

Finding 1: Kerala Achieved Early Mover Advantage and Mass Adoption

Kerala's rooftop solar journey demonstrates the effectiveness of sustained policy support. The state's 54.6% renewable energy share in installed capacity is among India's highest. The "10,000 Roof Top Solar PV" scheme (2011-12) established Kerala as a pioneer, achieving less than 1% system failure rate. The current PM Surya Ghar scheme has built on this foundation: over 2.84 lakh household installations and ₹2,000+ crore in subsidies demonstrate the scale of adoption.

Finding 2: Significant District-Level Disparities Exist

Ernakulam leads with 48,072 installations, followed by Thrissur (34,144) and Thiruvananthapuram (30,056), while Wayanad has only 1,675 installations. This disparity reflects differences in population density, urbanisation, institutional capacity, and perhaps consumer awareness. Companies concentrated in high-demand districts achieve greater installation volumes and economies of scale.

Finding 3: Market Structure is Fragmented but Maturing

With 1,525 authorised vendors, Kerala's market is highly competitive and fragmented. However, differentiation is emerging: INKEL Limited has achieved SP1B rating and national awards; Sun World Solar Systems maintains 4.9/5 customer ratings; Illumine Energy Solutions has completed 5,000+ projects. This suggests a market where reputation and quality are increasingly valued over price alone.

Finding 4: Structural Challenges Threaten Sustainability

The grid integration challenge is fundamental: only 36% of solar generation is consumed during daylight hours. KSEB faces ₹500+ crore annual losses from solar banking imbalance, creating a "tragedy of the commons" where solar adoption by a minority imposes costs on all consumers. This

finding validates hypothesis H5 regarding structural challenges driving industry transformation.

Finding 5: Regulatory Changes Are Reshaping the Market

The draft KSERC regulations restricting net metering to under 3 kW will significantly alter consumer economics and company business models. Companies that adapt to this new reality—by promoting battery storage, high-efficiency systems within 3 kW limits, or hybrid solutions—will likely gain competitive advantage. This validates hypothesis H4.

Finding 6: Quality Infrastructure is Being Developed

ANERT's initiatives—Akshaya Urja Service Centres, Souraveedhi App, and LSG-based subsidy distribution—address critical after-sales service gaps. These initiatives represent a significant effort to professionalize the installation sector and build consumer confidence.

2. Challenges and Barriers

Grid Integration Crisis: The fundamental mismatch between solar generation timing and Kerala's evening-peak demand creates structural financial stress for KSEB, with losses passed on to consumers through higher tariffs. This is the most significant challenge facing Kerala's solar sector.

Regulatory Uncertainty: The draft KSERC regulations introduce uncertainty that may deter investment and adoption. The shift from net metering to net billing reduces the financial case for new consumers, potentially slowing growth.

Consumer Protection: With 1,525 vendors, quality variability remains a concern. ANERT's initiatives are welcome, but comprehensive consumer protection mechanisms remain underdeveloped.

After-Sales Service: The "vanish after installation" problem identified by ANERT persists, though initiatives to establish service centres in all 140 constituencies aim to address this.

Financing Constraints: Despite subsidies, the upfront cost remains prohibitive for many households. Affordable financing options are essential for reaching the ₹2.5 lakh crore opportunity represented by Kerala's 98 lakh households.

3. Implications

For Policymakers

- Consider time-of-use tariffs to align solar generation with consumption
- Support battery storage adoption to address the generation-demand mismatch
- Strengthen vendor certification and consumer protection mechanisms
- Accelerate KSEB grid modernisation for two-way power flows

For Installation Companies

- Develop battery storage and hybrid system expertise
- Differentiate through quality, after-sales service, and consumer education
- Build capabilities for small-capacity high-efficiency systems (under 3 kW)
- Leverage ANERT accreditation and local partnerships

For Consumers

- Use ANERT's Souravedhi App for system registration and insurance
- Choose ANERT-approved vendors with proven track records
- Consider battery storage for maximum self-consumption
- Understand net metering changes and their financial implications

Conclusion

This study provides a comprehensive assessment of home solar plant installation companies in Kerala over the decade 2016–2026, revealing a sector that has achieved remarkable scale while confronting fundamental structural challenges. Kerala's rooftop solar capacity has grown to 2,233.79 MW, with the residential sector accounting for the dominant share. The PM Surya Ghar scheme has driven extraordinary adoption: over 2.84 lakh household installations, 2.67 lakh beneficiaries receiving subsidies, and more than ₹2,000 crore disbursed.

The installation company landscape in Kerala reflects both the sector's maturity and its fragmentation. With 1,525 authorised vendors, the market is highly competitive. Leading companies—including national players like Tata Power Solar and Kerala-based specialists such as INKEL Limited, Illumine Energy Solutions, Galian Watts, and Sun World Solar Systems—differentiate through brand reputation, government accreditation, customer ratings, and local expertise. Companies that combine quality installation, after-sales service, and subsidy facilitation have gained competitive advantage.

However, Kerala's solar success has created an unintended consequence: significant financial stress on KSEB. The mismatch between solar generation (peaking at midday) and Kerala's evening-peak demand means that only 36% of solar

generation is consumed during daylight hours. Solar banking imbalances reportedly cause losses exceeding ₹500 crore annually, with costs socialised across all consumers. The draft KSERC regulations restricting net metering to capacities under 3 kW represent a policy response that may impede future growth.

Looking forward, the sector faces a critical transition. The fundamental imperative is to align solar adoption with grid capacity and demand patterns. This will require:

1. **Grid Modernisation:** Investment in Kerala's distribution network for two-way power flows and real-time monitoring
2. **Battery Storage Adoption:** Encouraging behind-the-meter storage to increase self-consumption and reduce grid exports
3. **Time-of-Use Tariffs:** Aligning tariff structures with actual system costs
4. **Quality Infrastructure:** Strengthening ANERT's initiatives for vendor certification and after-sales service

For installation companies, the path forward involves adaptation: developing battery storage expertise, building service capabilities, and maintaining quality standards in a competitive market. For policymakers, the challenge is balancing Kerala's green energy ambitions with the financial sustainability of its electricity system. For consumers, the imperative is to navigate a changing regulatory landscape while securing the benefits of solar energy.

Kerala's solar journey offers valuable lessons for India and other developing economies: progressive policy can drive remarkable adoption, but structural challenges must be addressed for sustainable growth. The state's success in scaling rooftop solar from 10,000 homes to nearly 300,000 households demonstrate the potential of well-designed programs. The next decade will determine whether Kerala can overcome its grid integration challenges and achieve its vision of a green, energy-independent future.

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