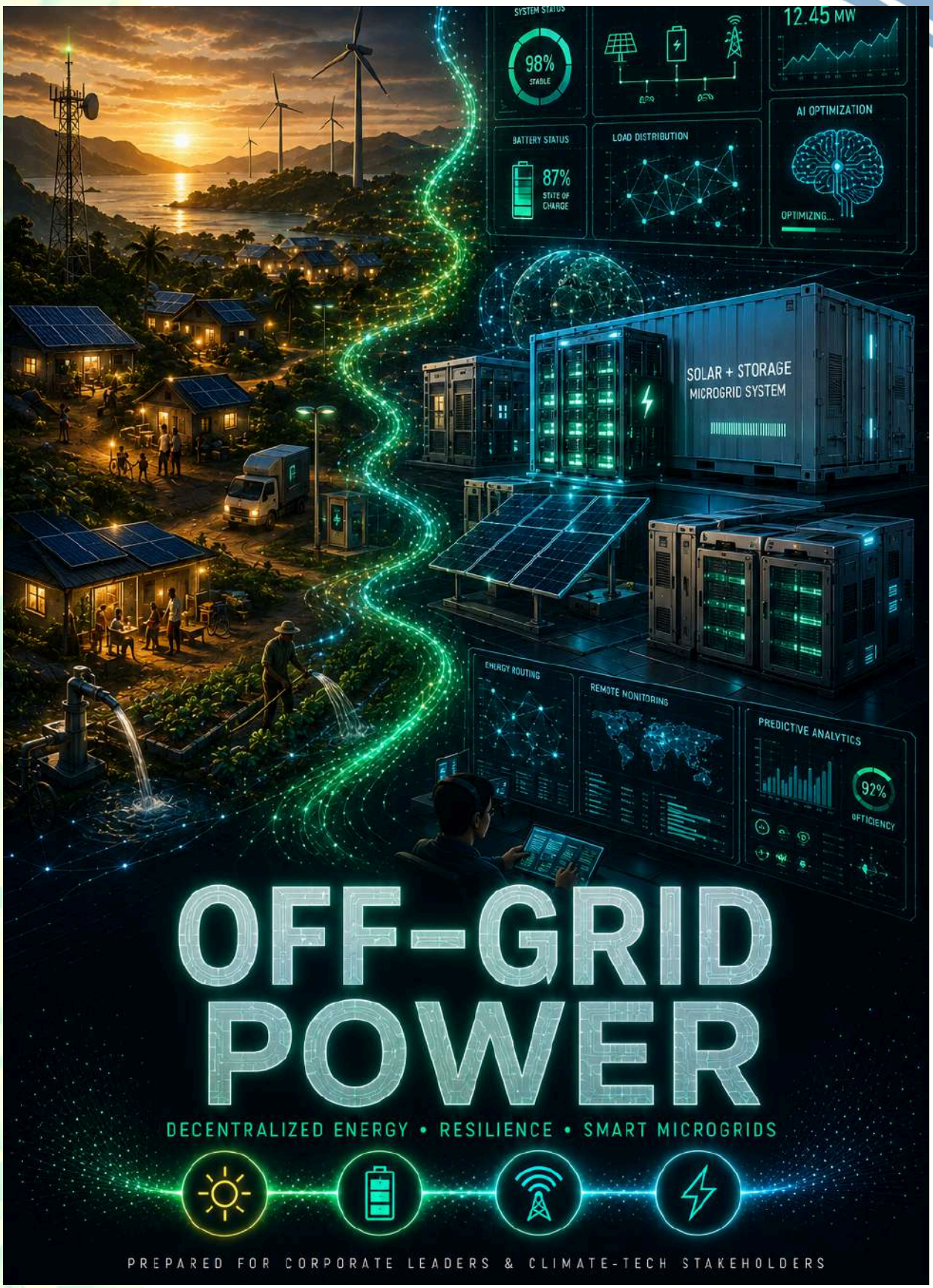
SYSTEM STATUS
98%
STABLE
12.45 MW
BATTERY STATUS
87%
STATE OF CHARGE
LOAD DISTRIBUTION
AI OPTIMIZATION
OPTIMIZING...
SOLAR + STORAGE
MICROGRID SYSTEM
ENERGY ROUTING
REMOTE MONITORING
PREDICTIVE ANALYTICS
92%
EFFICIENCY
OFF-GRID
POWER
DECENTRALIZED ENERGY • RESILIENCE • SMART MICROGRIDS
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

CO3@EAI

Energy Storage
Off Grid Power

This section provides key inputs on Off Grid Power Opportunities for corporate leaders.

Highlights

- Rapidly expanding demand from rural electrification, telecom towers, mining, agriculture, islands, and remote industrial sites where grid reliability is weak
- Cost competitiveness vs diesel as solar + storage hybrid systems increasingly undercut fossil backup generation
- Strong ESG and development alignment attracting concessional capital, climate finance, and impact investors
- Technology maturity in modular solar + battery microgrids enabling scalable, repeatable deployment models

Key recommendations for corporate leaders include:

- Focus on high-demand clusters (telecom, agri-processing, remote infrastructure) to build repeatable project pipelines with significant scale
- Develop hybrid energy platforms combining solar, storage, and backup generation for guaranteed uptime
- Integrate digital monitoring and remote asset management to reduce O&M costs and improve uptime
- Adopt energy-as-a-service commercial models to remove upfront capex barriers for customers

Opportunity Snapshot: Off Grid Power

Deliver decentralized electricity, independent of main grid, using solar and batteries

Market Signal

- Rising demand for **reliable backup** power in rural, telecom, and commercial segments
- Strong push for **decentralized renewable energy (DRE) solutions**
- **Annual Market size by 2030:** 15,000 - 17,000 ₹ Cr

What Makes or Breaks It?

- **Efficient last-mile distribution and service network**
- **Affordable financing models** (PAYG, leasing, microfinance)
- Reliable system design ensuring uptime and low maintenance

Why It Matters NOW?

- **Demand for 24/7 reliable power** due to unreliable grid supply
- **Government and CSR push** for energy access and rural development

Well Aligned Opportunity for

- **DRE startups and mini-grid developers**
- **NGOs / social enterprises** with rural reach
- **Telecom and commercial operators** needing reliable backup power

Key Challenges

- **Revenue constraints** due to low paying capacity in rural areas
- **High customer acquisition and distribution costs**

Business Model

- Deploy solar mini-grids in underserved rural clusters
- Offer solar & battery solutions for commercial backup (shops, telecom towers)
- Partner with MFIs/NGOs for financing and distribution

Introduction and Business Case

Even as India scales its grid, millions of people and enterprises in rural, remote and island areas still face unreliable access. Off-grid power — through solar home systems, microgrids, hybrid RE + storage and biomass/mini-hydro — delivers reliable electricity where the grid cannot. It cuts diesel dependence, powers rural livelihoods and anchors social infrastructure (schools, health centres).

For India's corporates and investors, it is both a social impact play and a fast-growing distributed energy market opportunity.

Market Potential for Off grid Power in India

Year	Market Size (₹ Cr)	Capacity Outlook	Drivers
2025	7,000-8,000	1-1.2 GW equivalent	Solar lanterns, SHS, microgrids for rural households.
2030	15,000-17,000	3-4 GW equivalent	Productive use (pumps, cold chains), C&I microgrids.
2040	25,000-30,000	8-10 GW equivalent	Deep integration into rural infra, agriculture and telecom.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Rural solar mini-grids (villages)	Household power, lighting, phone charging	Own–operate–maintain (IPP-like)	Rural electrification gap + anchor load demand
Commercial mini-grids	MSMEs, agri-processing, cold storage	Anchor-load–led mini-grid	Productive use of energy (PUE) driving revenues
Solar home systems (SHS)	Lighting, fans, TVs, basic appliances	Pay-As-You-Go (PAYGo)	Affordability via consumer financing
Energy-plus consumer finance	Energy + smartphones, TVs, appliances	Energy as fintech on-ramp	Untapped credit markets + customer lifetime value
Utility-backed off-grid	SHS + mini-grids	Utility-style regulated	Grid deferral

platforms		expansion	economics & policy support
Modular hybrid systems	Solar + battery + diesel	Scalable modular deployment	Reliability in weak-grid / transition zones
Productive-use focused systems	Irrigation, milling, refrigeration	Energy + equipment bundling	Income uplift for customers
Mesh & distributed architectures	Village-level peer energy sharing	Decentralized tech-led rollout	Lower capex + faster village coverage
High-service SHS providers	Residential + small business	Asset quality & service-led retention	Customer trust and repayment performance
Off-grid technology enablers	Controllers, storage, microgrid software	Hardware + software sales / licensing	Scale via ecosystem adoption rather than assets

Typical Project Capacities & Investments Required in India

Project Type	Typical Capacity	Indicative CapEx (₹ Cr)	Notes
Solar DC Microgrids (nano-utility)	10-50 kW PV + 10-100 kWh BESS	0.10-0.50	Hamlet clusters; DC appliances; pay-go metering.
Rural AC Minigrids (anchor-business-community)	50-500 kW PV + 100-1,000 kWh BESS + DG	0.6-4.0	Anchor loads (towers/cold rooms) stabilize revenue.
Commercial/Industrial Off-grid (C&I estates, resorts, mines)	0.5-5 MWp PV + 1-10 MWh BESS	3-40	Diesel displacement; EMS-driven hybrid ops.
Agriculture Solar Pumps Clusters	0.1-1 MWp shared PV	0.5-3.0	Feeder-linked or community pumps; IoT control.
Telecom/Remote Infra Power	5-50 kW hybrid PV+BESS	0.10-0.80	Tower, railway, pipeline, border ops; high uptime.
Institutional Campuses (schools/PHCs)	20-200 kW PV + 40-400 kWh BESS	0.20-1.6	Healthcare cold chain, e-learning reliability.
Island/Mountain Resorts & Eco-tourism	200-800 kW PV + 0.5-3 MWh BESS	1.5-8.0	Diesel hedging, brand premium, noise/air benefits.

Underlying Technologies & Processes

Element	Options	Key Traits
Generation	Solar PV, biomass gasifiers, micro-hydro, wind	Tailored to local resources; scalable modular systems.
Storage	Li-ion batteries, lead-acid, emerging sodium-ion	Ensures reliability; sizing depends on load profile.
Distribution	AC/DC microgrids, solar home systems	Connects households, SMEs, community infrastructure.
Productive use applications	Pumps, cold storage, milling, e-mobility charging	Increases income & demand sustainability.
Business models	Pay-as-you-go, community ownership, PPPs	Critical for viability and scaling.
Digital enablement	Smart meters, IoT monitoring, mobile payments	Improves efficiency, billing and demand-side management.

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Demand Uncertainty & Customer Credit Risk	Rural and remote consumers often have limited payment capacity; variable energy demand patterns	Revenue instability and higher default risks	Many off-grid projects serve low-income or remote areas with inconsistent consumption	Innovative payment models (PAYG, prepaid meters), community-based systems improve collections
High Capital Cost & Financing Constraints	Upfront cost of solar PV, batteries, microgrids, distribution infrastructure	Long payback periods; difficult access to low-cost financing	Limited availability of concessional finance for small-scale distributed projects	Blended finance, impact investors, and subsidy-linked models improve viability
Operations &	Remote	Increased O&M	Geographic	Remote

Maintenance Challenges	locations, lack of skilled technicians, battery replacement costs	expenses and system downtime	diversity across India increases service complexity	monitoring, modular systems, and local workforce training critical
Policy & Grid Expansion Uncertainty	Main grid extension into previously off-grid areas can reduce demand for microgrids	Stranded asset risk; uncertain long-term planning	Government electrification initiatives expanding grid rapidly	Hybrid models allowing grid integration or backup services reduce risk
Supply Chain & Technology Reliability	Battery supply, inverter quality, spare parts logistics	Downtime affects customer trust and project economics	Dependence on imported components; technology evolution rapid	Standardization, reliable OEM partnerships, and localized inventory improve resilience

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Husk Power Systems	Solar/biomass hybrid microgrids across Bihar & UP; part of a 200+ sites.
Oorja Development Solutions	Off-grid solar for irrigation and agro-processing.
MLL Energy / Mlinda	Decentralised microgrids in Jharkhand & West Bengal.
SELCO Solar	Solar home systems for households, schools and healthcare.
Tata Power Renewable Microgrid Ltd.	Targeting 10,000 solar-hybrid microgrids by 2026.
DESI Power / Gram Power	Early movers in biomass- and solar-based microgrids.

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Energy as a customer-lifetime platform	Cross-sell finance, appliances, data services	Monetizes beyond kWh; high switching costs
Anchor-load-led mini-grids	Rural industrial parks,	Bankable revenues + faster

	agri-clusters	breakeven
Energy-enabled fintech	Mass-market consumer lending platforms	Converts energy access into credit access
Productive-use-first electrification	Energy-as-income infrastructure	Customers pay because income rises
Modular & upgradeable systems	Transitional energy infrastructure	Extends asset life, reduces stranding
Mesh & distributed architectures	Software-led village electrification	Lower capex, faster rollout
Carbon-monetized off-grid	Carbon-backed energy expansion	Second revenue stream
Utility-grade off-grid	Grid deferral & regulated returns	Low cost of capital
Service-quality differentiation	Premium rural energy brands	Higher repayment, brand trust
Off-grid tech platformization	Licensing & ecosystem control	Scale without owning assets

Concentric & Satellite Opportunities

- Anchor-first minigrid developers: Concentric SPVs pairing PV+BESS with telecom/cold-chain loads and pre-paid smart metering for bankable cashflows.
- Productive-use appliance bundles: Efficient motors, pumps, mills and cold rooms financed with pay-as-you-use to raise utilisation.
- Battery leasing & O&M networks: Swap-ready or modular BESS with performance guarantees and rural service hubs.
- Digital billing & AMI platforms: UPI-enabled pre-paid, remote disconnect, theft analytics and carbon-ready MRV.
- Climate-resilient BOS manufacturing: Tropicalised enclosures, dust-proof PCS, corrosion-safe MMS and cyclone-rated mounts.
- Rural EV charging nodes: Satellite hubs using minigrids to power 2W/3W fleets and agri-EV implements.
- Training & franchise programs: Local entrepreneur models for O&M, collections and productive-use enablement to scale thousands of sites.

Key Takeaway for Senior Management

Takeaway	Details
Off-grid power is an energy reliability business, not just generation	• Customers buy uptime, not kilowatt-hours. The value lies in guaranteed availability in weak-grid or no-grid zones • ***Examples**:* telecom tower uptime contracts, mining operations, cold-chain storage, remote healthcare • **Innovation focus:** smart hybrid controllers, predictive uptime analytics, remote dispatch optimization • **Competitive advantage:** firms that guarantee reliability command premium contracts and long-term customer lock-in
Hybrid system intelligence determines lifecycle economics	• Solar + storage + backup integration is more important than component cost • ***Sub-components**:* battery management systems, load forecasting, hybrid inverters, energy management software • **Innovation focus:** AI-driven energy orchestration and demand matching
Digital asset management is the real scalability lever	• Off-grid portfolios fail without centralized monitoring and predictive maintenance • ***Examples**:* IoT sensors, remote diagnostics, fleet-wide analytics dashboards • **Innovation focus:** autonomous microgrid management platforms • **Competitive advantage:** lower O&M cost and higher uptime across distributed assets
Cluster-based deployment beats isolated installations	• Economics improve when assets are deployed in geographic or sector clusters • ***Examples**:* telecom corridors, rural industrial hubs, island grids, agri-processing zones • **Competitive advantage:** shared infrastructure and portfolio optimization, repeatable deployment templates accelerate scaling
Energy-as-a-service models unlock demand	• Customers prefer service contracts over capital purchases • ***Examples**:* uptime PPAs, microgrid leasing, subscription energy models • **Competitive advantage:** recurring revenue and customer stickiness

Next Steps for Corporate Leaders

Off-grid and behind-the-meter power solutions are gaining traction as corporates seek resilient, low-carbon, and cost-predictable alternatives to unreliable grids or diesel-based systems. Solar-battery hybrids, biomass/biogas gensets, microgrids, and modular containerized power units are increasingly adopted across remote industrial sites, mining, construction, telecom, agriculture, and rural commercial operations. As digital controls mature and energy-as-a-service models expand, off-grid power is evolving into a strategic enabler of energy resilience and decarbonization.

This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market.

Connect with Team EAI to know more about this opportunity and take your corporate's initial steps. Send a note to consult@eai.in or talk to Muthukrishnan - 9952910083