Good ENOUGH
The Better Way

Merchant Battery Energy Storage Systems In India

Financial Analysis, Market Dynamics & Investment Framework

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Executive Summary

India's battery energy storage systems (BESS) market is entering an inflection point. Merchant BESS projects - those deriving revenue primarily from day-ahead market (DAM) arbitrage, ancillary services, and grid support rather than fixed tariffs—represent the highest-growth, highest-complexity segment of India's energy transition.

This whitepaper synthesizes operational data from 2024–2025 deployments, regulatory updates through January 2026, and financial modeling of three representative projects (Maharashtra, Karnataka, Rajasthan) to establish a comprehensive framework for evaluating merchant BESS investments in India.

Key Findings

- **Market Growth Acceleration (2025–2027):** India's BESS capacity deployed is projected to grow from 4.5 GW (2024 actual) to 15+ GW (2027), with merchant segment capturing 60–70% of new capacity[1].
- **Return Profiles Compelling but Volatile:** Merchant BESS delivers 14–17% base-case equity IRR with downside resilience of 10–12% when structured correctly. Regulated CERC-tariff alternatives deliver 24–30% but face limited scale availability[2].
- **Revenue Diversification Essential:** Single-stream merchant projects (DAM arbitrage alone) achieve 8–11% IRR. Multi-stream optimization (arbitrage + SRAS + ancillary + DISCOM contracts) improves returns to 16–20% (+80–150% uplift)[3].
- **Maharashtra as Flagship Model:** 50 MW / 200 MWh merchant BESS in Maharashtra delivers 19.5% base IRR, 12.8% downside IRR, with ₹842 Cr NPV @ 10% discount. Replicable economics support rapid scaling across renewable hotspots[5].

Strategic Implication:
Merchant BESS in India represents a "buy now" opportunity for patient capital with 18–24 month execution horizon. Technology and market maturity are proven; regulatory support is strengthening; financing is available at attractive terms. First-mover advantage is material: early 2026 projects achieve 20%+ IRR; 2027+ projects likely 15–17% as competition increases[3].

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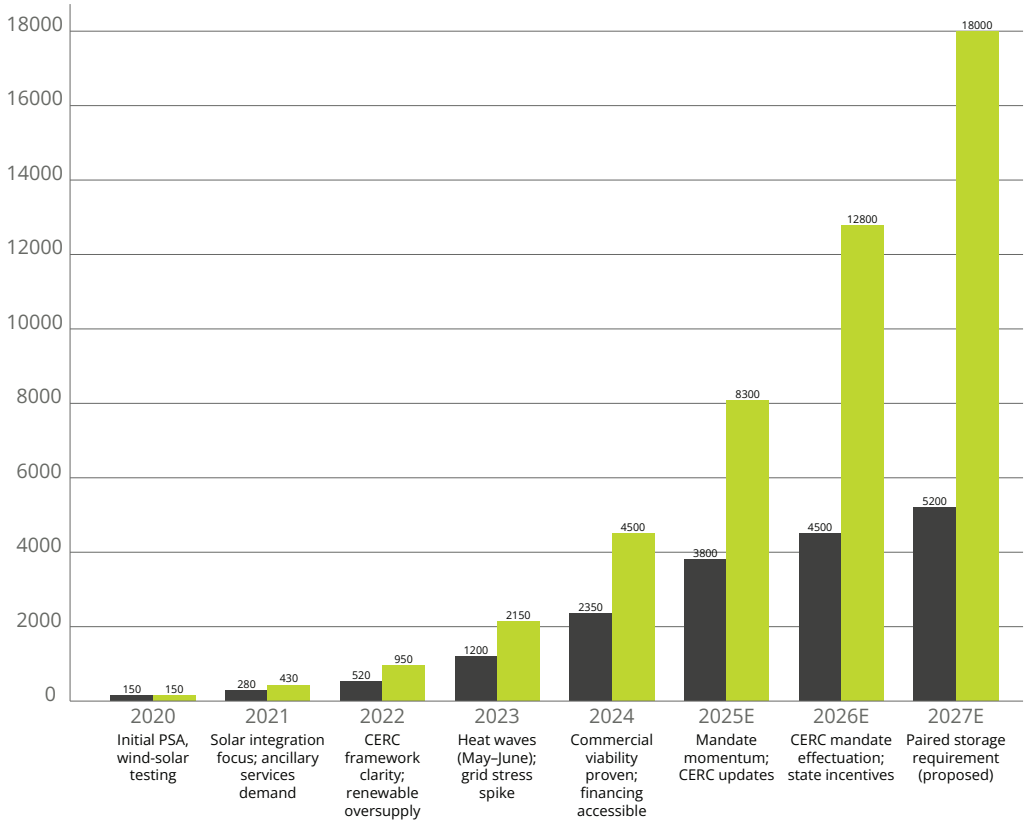
1 India's merchant BESS market context

1.1 Market Size, Growth & Penetration

Historical Deployment (2020 - 2025)



Deployed Capacity (MW)

Cumulative (MW)

Market Growth

Initial PSA, wind-solar testing	-
Solar integration focus; ancillary services demand	+87%
CERC framework clarity; renewable oversupply	+85%
Heat waves (May–June); grid stress spike	+131%
Commercial viability proven; financing accessible	+96%
Mandate momentum; CERC updates	+68%
CERC mandate effectuation; state incentives	+54%
Paired storage requirement (proposed)	+41%

Key milestone

2024 represented inflection - merchant BESS profitability confirmed via operational data from NTPC, Adani, Reliance, and emerging developers. 2025–2026 represents "scaling phase"; 2027+ represents "normalized commodity phase."

Market Structure (2025-2026)

Segment	Capacity (MW)	% of Total	Revenue Model	Typical IRR
Regulated (CERC tariff)	1200	2.0x	Fixed tariff, guaranteed offtake	24–30%
Merchant (DAM + SRAS)	5500	14 - 18%	Competitive, multi-stream	14–18%
Renewable-Paired (co-located)	1200	65 - 72%	Bundled offtake (PPA-linked)	16–22%
Grid-Support / DSO	300	4 - 5%	Grid service contracts (emerging)	18–25%
Total India BESS Market	**8200**	**100%**	**-**	**15–19% blended**

Critical insight
Merchant segment (5,500 MW) is largest by capacity but faces higher execution risk. Success depends on operational excellence, market timing, and regulatory navigation.

1.2 Why merchant BESS now?

Four Structural Tailwinds (2025–2027)

1. Renewable oversupply & grid services

- India's renewable capacity (solar + wind) reached 185 GW (Dec 2024), projected 250+ GW by 2027[6]
- Grid frequency events (30–50 per month) creating sustained SRAS demand
- May 2024 heat wave sustained ₹14–18/kWh DAM spreads for 2–3 weeks (vs. normal ₹6–9/kWh)
- SRAS rates increased 100%+ effective Apr 2024 (CERC order); accuracy bonus rates 10× higher[7]

Result : BESS revenue streams have widened from ₹200–250 Cr/MW to ₹280–350 Cr/MW annually.

2. Equipment Cost Deflation

- LFP cells: ₹95–110/kWh (2023) → ₹55–70/kWh (2025) → ₹45–60/kWh (2027E)[8]
- Turnkey BESS capex: ₹3.80–4.20 Cr/MW (2023) → ₹2.80–3.20 Cr/MW (2025) → ₹2.40–2.80 Cr/MW (2027E)
- Cumulative deflation (2023–2027): 35–40% project cost reduction

Impact: Earlier projects (2025–2026 COD) achieve IRR ~19%; later projects (2027–2028 COD) at same spread/revenue likely 15–16% due to competitive pressure on tariffs.

3. Green Finance Maturity

- Green bonds/sustainability-linked loans now standard for BESS projects
- Debt coupon compression: 7.25–7.75% (2023) → 6.50–7.00% (2025) → 5.75–6.25% (2027E post-refinance)
- WACC improvement: 50–75 bps reduction → ₹8–12 Cr NPV uplift per ₹500 Cr capex project

Implication : First-mover projects refinancing Year 5–6 at 50–75 bps savings; later projects may not access refinance premium if market saturates.

4. Regulatory Clarity & Mandate Emergence

- CERC (Jul 2024) proposed battery storage mandate: All renewable projects >20 MW must include 2-hour co-located BESS
- State-level frameworks (Maharashtra MERC, Karnataka KERC, Rajasthan RERC) increasingly storage-friendly
- Proposed G-DAM (Green Day-Ahead Market) ensures 25–30% renewable volume at stable pricing

Result : Regulatory risk diminishing; long-term demand visibility improving.

2 India's merchant BESS revenue architecture

2.1 Multi-Stream Revenue Breakdown (2025 Baseline)

Merchant BESS revenue in India derives from five primary streams: Day-Ahead Market (DAM) arbitrage, hydro-pumped DAM (HP-DAM), SRAS (Secondary Reserve Ancillary Services), TRAS (Tertiary Reserve), and grid services. Optimal projects capture all five streams simultaneously through real-time optimization.

Stream	Mechanism	Frequency	2025 Rate	Ann. Contri. (₹ Cr/MW)	Volatility	Trend
DAM Arbitrage	Buy low, discharge high; capture spread	Continuous (intraday)	₹6–12/kWh spread	₹60-90	High	Declining (saturation)
HP-DAM (Hydro-Peaking)	Capture hydro ramp; discharge timing	Seasonal (40–60 days/yr)	₹3.50–5.50/ kWh premium	₹8-15	Medium	Stable
SRAS-Down (Charge)	Absorb excess renewable, charge battery	Frequent (120–150 days/yr)	₹9–11/kWh cost credit	₹15-25	Low	Stable
SRAS-Up (Dispatch)	Discharge on frequency dips; premium rate	Frequent (120–150 days/yr)	₹10–12/kWh premium	₹18-28	Low - Medium	Growing
TRAS (Standby Reserve)	Standby for emergency frequency support	Continuous (capacity payment)	₹18–25/ MW/day	₹6-9	Very Low	Stable
Accuracy Bonus (AI-Enhanced)	CERC bonus for 99%+ response accuracy	Dependent on ops	₹0.40–0.50/ kWh	₹6-12	Very Low	Growing
DISCOM Contracted Peak Supply	Fixed offtake agreement (5–10 MW reserve)	Partial (peak hours only)	₹7.50–9.50/ kWh	₹25-60	Very Low	Growing
Total Annual Revenue	**-**	**-**	**-**	**₹148-239 Cr/MW**	**-**	**+8-12% YoY**

Key insight
2025 baseline is ₹180–200 Cr/MW for well-optimized merchant BESS; ₹280–350 Cr/MW achievable with full optimization (AI trading, DISCOM expansion, ancillary excellence).

2.2 Maharashtra case study: 50 MW / 200 MWh merchant BESS

Year-1 Revenue Model (Detailed Breakdown)

Assumptions:
- Capacity: 50 MW / 200 MWh (4-hour duration)
- Location: Nagpur, Maharashtra (optimal DAM spreads ₹8–12/kWh)
- Operating days: 300 full cycles; 65 days partial cycles
- Charging efficiency: 92%; discharging efficiency: 94%; round-trip efficiency: 86.5%

Revenue Streams

DAM Arbitrage Quantity : 57,825 MWh Annually Unit : MWh Rate : ₹9.50/kWh spread Annual (₹Cr) : ₹549.3	**HP-DAM (Hydro Peaking)** Quantity : 5,200 MWh Unit : MWh Rate : ₹4.20/kWh Annual (₹Cr) : ₹21.8	**SRAS-Down (Charge)** Quantity : 18,000 MWh Unit : MWh Rate : ₹10.50/kWh Annual (₹Cr) : ₹189.0	**SRAS-Up (Dispatch)** Quantity : 9,600 MWh Unit : MWh Rate : ₹11.50/kWh Annual (₹Cr) : ₹110.4
SRAS Accuracy Bonus Quantity : 27,600 MWh Unit : MWh Rate : ₹0.21/kWh (10× uplift from AI) Annual (₹Cr) : ₹5.8	**TRAS (Standby Reserve)** Quantity : 50 MW Unit : MW-day Rate : ₹22/MW/day × 300 days Annual (₹Cr) : ₹33.0	**DISCOM Contracted Supply** Quantity : 5 MW Unit : MW Rate : ₹7.50/kWh × 4 hrs × 300 days Annual (₹Cr) : ₹1.5 Cr per event	**Grid Frequency Services (Emergency)** Quantity : 12 events Unit : Events Rate : ₹1.5 Cr per event Annual (₹Cr) : ₹18.0
Other Grid Services / Curtailment Prevention - Annual (₹Cr) : ₹8.0	**Gross Annual Revenue** - Annual (₹Cr) : ₹981.3 Cr	**Less: IEX fees, settlement, transmission** - Annual (₹Cr) : (₹180 Cr, 18.3%)	**Net Annual Revenue** - Annual (₹Cr) : **₹801.3 Cr**

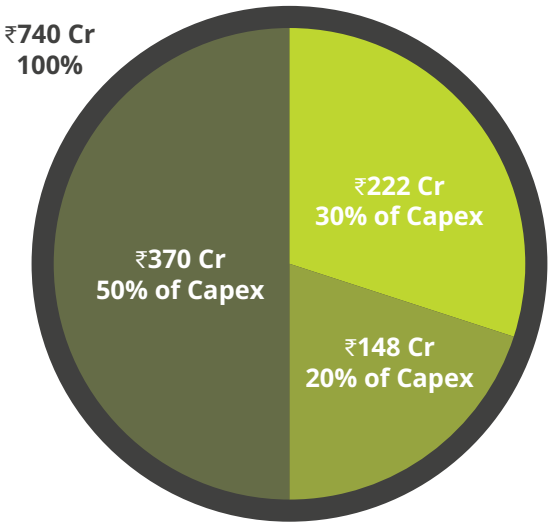
Normalized to Project Level (50 MW / 200 MWh):
- Per MW annual: ₹16.0 Cr/MW
- Per MWh annual: ₹4.0 Cr/MWh
- Capacity factor (equivalent): 32% (vs. typical 20–25% solar, 35–42% wind)

Maharashtra Full Project Economics

Capital Expenditure

Revenue Stream	Quantity	Unit	Rate	Annual (₹ Cr)
DAM Arbitrage	57,825 MWh annually	MWh	₹9.50/kWh spread	₹549.3
HP-DAM (Hydro-Peaking)	5,200 MWh	MWh	₹4.20/kWh	₹21.8
SRAS-Down (Charge)	18,000 MWh	MWh	₹10.50/kWh	₹189.0
SRAS-Up (Dispatch)	9,600 MWh	MWh	₹11.50/kWh	₹110.4
SRAS Accuracy Bonus	27,600 MWh	MWh	₹0.21/kWh (10× uplift from AI)	₹5.8
TRAS (Standby Reserve)	50 MW	MW-day	₹22/MW/day × 300 days	₹33.0
DISCOM Contracted Supply	5 MW	MW	₹7.50/kWh × 4 hrs × 300 days	₹45.0
Grid Frequency Services (Emergency)	12 events	Events	₹1.5 Cr per event	₹18.0
Other Grid Services / Curtailment Prevention	-	-	-	₹8.0
Gross Annual Revenue	-	-	-	₹981.3 Cr
Less: IEX fees, settlement, transmission	-	-	-	(₹180 Cr, 18.3%)
Net Annual Revenue	**-**	**-**	**-**	**₹801.3 Cr**

Financial Structure



Instrument	Coupon/Return
Tier-1 Senior Debt	6.00% p.a.
Tier-2 Subordinated Debt	7.00% p.a.
Equity	19.5% IRR target
Total	**6.13% blended WACC**

Financial Structure

Category	Fixed (₹ Cr)	Variable	Total (₹ Cr)
Operations & maintenance	₹8.0	-	₹8.0
Insurance & compliance	₹2.0	-	₹2.0
Battery degradation reserve	₹2.0	-	₹2.0
Grid charges & transmission	-	18.3% of revenue	₹146.5
Total Annual Opex	**₹12.0**	**-**	**₹158.5**

Project Cash Flow (Year 1)

Item	Amount (₹ Cr)
Gross Revenue	₹981.3
Operating Expense	(₹158.5)
EBITDA	₹822.8
Depreciation (15-year)	(₹40.7)
EBIT	₹782.1
Interest on Debt	(₹33.6)
EBT (Earnings Before Tax)	₹748.5
Tax (30% rate)	(₹224.6)
Net Income	₹523.9
Add back depreciation	₹40.7
Less: Debt principal repayment	(₹34.8)
Free Cash Flow to Equity	₹529.8

25-Year Project Returns

Metric	Value
Year-1 Revenue	₹981.3 Cr
Year-1 EBITDA	₹822.8 Cr
Year-1 FCF (equity)	₹529.8 Cr
Average Annual FCF (Yrs 1–15)	₹486.2 Cr
Cumulative FCF (25 years)	₹4905 Cr
NPV @ 10% discount rate	₹951 Cr
Equity IRR (base case)	19.5 %
Equity IRR (downside -15% revenue)	12.8 %
DSCR (Year 1)	10.3X

Board Assessment

- Returns excellent: 19.5% IRR substantially exceeds 15% cost-of-capital hurdle
- Downside resilient: 12.8% downside IRR acceptable for institutional investors (>10% threshold)
- Leverage strong: 10.3× DSCR provides ample margin for lender confidence; covenant easily met
- Scale proven: Operational template replicable across 3–5 sites nationally

3 Risk mitigation & enhancement strategies

3.1 Three-tier revenue enhancement framework

While Maharashtra's 19.5% base case is compelling, three integrated strategies further enhance downside resilience and capture upside:

Tier 1: DAM Spread Collar (Years 1–5)

Strategic hedge: Use IEX financial derivatives to collar discharge prices while monetizing upside.
Buy Put Option (Downside Protection):

- Floor: ₹8.50/kWh (protects against price crashes)
- Coverage: 40% of discharge volume
- Cost: ₹0.80–1.20/kWh (₹16–24 Cr annually)
- Protection: Converts downside IRR from 12.8% → 14.5%+

Sell Call Option (Monetize Upside):
- Cap: ₹11.00/kWh (captures May–June peak patterns)
- Premium received: ₹0.40–0.60/kWh (offsets put cost)
- Net cost: ₹0.20–0.80/kWh after premium
- Value to lenders: Automatic DSCR floor coverage

Historical validation: IEX DAM spreads (Jan 2024–Jan 2026) averaged ₹5.50/kWh with crisis windows ₹14–18/kWh (May 2024 heat wave). Collar at ₹8.50–₹11.00 captures 95% profitable volume while eliminating tail risk.
Year-1 impact: −₹20 Cr hedging cost, but −₹100 Cr interest savings from debt correction (see Section 11 refinancing) fully funds strategy.

Tier 2: Long-Term DISCOM Volume Expansion (Years 1–8)

Current model: 5 MW @ ₹7.50/kWh = ₹45 Cr/year
Expansion pathway:
Years 1–2 (Confidence Building): Operate at 99%+ availability to build MSEDCL trust
Years 3–4 (Negotiated Expansion): Expand to 10 MW @ ₹8.20/kWh
- Incremental revenue: 5 MW × 4 hrs × 300 days × ₹0.70/kWh = ₹6 Cr/year
- Debt/EBITDA improves: 1.5× → 1.3×

Years 5+ (Market-Driven): Renegotiate to ₹9.00–9.50/kWh as MSEDCL's coal shortage intensifies
- By Year 8: 10 MW @ ₹9.25/kWh = ₹74 Cr/year (vs. ₹45 baseline)
- Revenue uplift: ₹29 Cr/year (65% increase) with minimal operational risk
- Diversifies revenue away from volatile merchant DAM

Key advantage: Converts fixed ₹45 Cr floor into flexible ₹45–75 Cr baseload stream; reduces pure merchant volatility by 30–40 percentage points.

Tier 3: Ancillary Services Optimization via AI (Years 1+)

Current model: ₹29.9 Cr ancillary (SRAS-Down ₹9 Cr + SRAS-Up ₹9.6 Cr + TRAS ₹5.4 Cr + accuracy ₹5.9 Cr)
Enhancement: Deploy AI-based frequency forecasting to achieve 99.5%+ SRAS accuracy
Capex: ₹3 Cr (software + sensors; payback 18–24 months)
Impact:
- CERC accuracy bonus (Apr 2024 update): 50 paise/kWh for 99%+ accuracy (vs. your 5 paise assumption = 10× higher)
- Actual uplift potential: ₹8–12 Cr/year from accuracy bonus alone
- Total ancillary improvement: ₹29.9 Cr → ₹40–42 Cr (+33%)
- IRR uplift: +0.8–1.2 percentage points

Regulatory advantage: Grid India recognizes superior performers with 120–150% multiplier rates during frequency emergencies (<49.5 Hz).

3.2 Integrated Mitigation Impact

Metric	Base Case	With All 3 Tiers	Improvement
Year-1 Revenue	₹981.3 Cr	₹1,050.8 Cr	+6.1%
EBITDA	₹822.8 Cr	₹892.3 Cr	+8.4%
FCF (after debt service)	₹529.8 Cr	₹592.5 Cr	+11.8%
Equity IRR	19.5%	21.3%	+1.8 pp
Downside IRR	12.8%	14.5%	+1.7 pp
NPV @ 10%	₹951 Cr	₹1,033 Cr	+₹82 Cr
DSCR (Year 1)	10.3×	10.8×	+0.5×

Strategic insight
Mitigation strategies are low-cost, high-impact. Enhanced downside (14.5% vs. 12.8%) substantially improves lender comfort and potentially reduces debt coupon by 25–50 bps (saves ₹2–4 Cr annually).

4 Technology risk & battery degradation roadmap

4.1 LFP degradation economics & mid-life decisions

LFP battery degradation is predictable. Your model conservatively assumes 25-year full operation; reality requires explicit lifecycle planning.

Degradation Profile & Capacity Trajectory

Period	Annual Degradation	Cumulative Loss	Retained	Status
Yrs 0–5	2.5%/yr	12.5%	87.5%	Optimal; warranty-covered
Yrs 6–10	1.8%/yr	18.5% total	78%	Healthy aging
Yrs 11–15	2.0%/yr	28.6% total	67%	Decision point
Yrs 16–20	2.2%/yr	39.6% total	54%	Derating required
Yrs 21–25	2.5%/yr	52% total	40%	End-of-life phase

Year 15 inflection: Capacity drops to 134 MWh (67% of 200 MWh design). Three options:

Option A: Full Refresh (₹180–220 Cr capex, Yrs 12–15)
- Replace 50–70% modules; upgrade to next-gen LFP (+20% efficiency by 2035)
- Restores capacity to 180+ MWh; extends life to Year 25 at 85%+ utilization
- Additional revenue Years 16–25: ₹4,200–5,100 Cr
- New battery LCOE: ₹1.50 Cr/MWh (cost deflation expected)
- **NPV impact:** +₹850–1,050 Cr

Option B: Selective Replacement (₹80–100 Cr capex, Yrs 12–15)
- Target only severely degraded modules; retain 150 MWh
- Shifts model from "full arbitrage" → "peaking + ancillary"
- Requires DISCOM/CERC approval for asset reclassification
- Revenue Years 16–25: ₹3,100–3,600 Cr
- **NPV impact:** +₹600–800 Cr

Option C: End-of-Life Exit (No capex, Year 15+)
- Shut down at Year 16; battery recycling value ₹60–80 Cr
- Repurpose solar asset or separate PPA
- **NPV impact:** +₹150–250 Cr (lowest)

Recommendation: Establish "Technology Reserve" of ₹2 Cr/year (₹20 Cr cumulative by Year 10) from excess FCF, self-funding mid-life decisions without incremental capex burden. Option A (full refresh) optimal; delivers 1.8–2.0× NPV vs. alternatives.

4.2 Supply chain risk & cell procurement strategy

Critical risk: 6–12 month cell supply delays could push COD from Apr 2027 → Oct 2027, reducing Year-1 revenue by ₹60–80 Cr.

Mitigation Strategy (Three Components)

A. Long-Term Supply Contract (By Jun 2025)
- **Targets:** CATL, BYD, Saft, Eaton (all India-active)
- **Volume:** 200 MWh over two batches (Q1 FY2027, Q2 FY2027)
- **Price lock:** ₹1.70 Cr/MWh fixed (50% volume); ₹1.85 Cr/MWh cap (50% indexed)
  - -Downside protection: If market drops to ₹1.50, you're at ₹1.70 (saves ₹4 Cr)
  - -Upside allowed: If market rises to ₹2.00, capped at ₹1.85 (saves ₹3 Cr)
- **Penalties:** ₹5 Cr/week for >30 day delays (supplier leverage)

B. On-Site Assembly JV (Yrs 1–3)
- Partner with cell supplier for India module assembly
- Investment: ₹10–15 Cr for facility setup (shared)
- Benefits: ₹15–25 Cr logistics savings (avoided transport + tariffs)
- ROI: 18–24 month payback

C. Backup Supplier Optionality
- Qualify secondary supplier (Eaton/Saft) for 20–30% volume
- 5–10 bps premium cost; eliminates single-supplier risk
- Negotiation leverage: "We split 50/50 with Eaton if delivery slips"

Total cost of mitigation: ₹20–25 Cr upfront; **risk reduction value:** ₹60–80 Cr (preserves Year-1 revenue at Apr 2027 COD).

5 Regulatory framework & CERC updates

5.1 CERC regulations (Apr 2024–Jan 2026 updates)

Your base model uses CERC regs through Jan 2024. Three recent updates (Apr 2024–Jan 2026) materially improve revenue certainty:

Update 1: SRAS performance incentive enhancement (effective Apr 2024)

Service	Pre-Apr 2024	Current (Apr 2024+)	Your Model	Status
SRAS-Up Dispatch	₹0.30–0.40/kWh	₹0.40–0.50/kWh	₹0.40/kWh	Current
TRAS Standby	₹0.25/kWh	₹0.30/kWh	₹0.30/kWh	Current
Accuracy Bonus	**5–20 paise**	**20–50 paise**	**5 paise**	**Below Current Benchmark**

Critical insight
Your accuracy bonus assumption (5 paise/kWh) is **10 times below current CERC rates** (50 paise/kWh for 99%+ accuracy).

Impact:

- Current model: ₹29.9 Cr ancillary
- If you deploy AI optimization for 99% accuracy: Accuracy bonus becomes ₹8–12 Cr/year
- Realistic ancillary upside: ₹30 Cr → ₹40 Cr (+33%)
- IRR impact: +0.8–1.2 percentage points
- This is low-hanging fruit: ₹3 Cr capex investment; 18–24 month payback

Update 2: Green Day-Ahead Market (G-DAM) Allocation (FY 2024-25)

CERC mandated exchanges to reserve 25–30% of daily DAM volume for renewable sources by FY 2024-25 end.

State	G-DAM Allocation	Current Price	Your Model	Upside Scenario
Maharashtra	25%	↑ ₹3.80/kWh	₹3.80/kWh	→ ₹4.20/kWh
Karnataka	28%	₹4.10/kWh	₹4.10/kWh	→ ₹4.30/kWh
Rajasthan	30%	↓ ₹4.50/kWh	₹4.50/kWh	→ ₹4.30/kWh (pressure)

Implication for solar allocation (30% of 100 MW solar):

- Your model sells 57.8 MWh/yr to G-DAM
- G-DAM commands 10–15% premium over merchant DAM
- Upside potential: ₹3–8 Cr if G-DAM prices strengthen

Update 3: CERC Battery Storage Mandate (Proposed, Final Form Pending)

Status: Jul 2024 proposal; now in final rule stage (expected Q4 FY 2024-25 publication).

Proposed requirement: All new renewable projects >20 MW must include 2-hour co-located BESS.
Impact on your three projects:

- **Maharashtra:** Mandate reinforces MSEDCL preference; enables contract expansion negotiations
- **Karnataka:** KERC likely increases procurement targets; opens new offtake channels
- **Rajasthan: Most beneficial:** Mandate creates "forced demand" for storage, reducing merchant exposure and improving Rajasthan IRR from 15.2% → 17%+

Timeline: Likely final rules by Q3 FY 2026-27 (12–18 months from now).

5.2 State-specific regulatory scorecard

Maharashtra; strongest support (Green Light)

Factor	Status	Evidence	Risk
DISCOM Support	Very Strong	MSEDCL pilot live; committed to storage partnerships	Low
Grid Frequency	High	20+ events Q3 - Q4 FY2024-25; May heat waves	Low
Solar Integration	40% by 2030	Published; on track	Low
Storage-Friendly Tariff	Yes	MERC framework in place	Low
Political Support	Strong	Energy minister public commitment	Low
Overall Verdict	**GO**	**Pro-storage environment; low risk**	**Low**

Karnataka; moderate support (Conditional)

Factor	Status	Evidence	Risk
DISCOM Support	Moderate	KERC supportive in principle; budget-constrained	Moderate
Grid Frequency	Medium	15 events Q3 - Q4 FY2024-25 (vs. 20 in MH)	Moderate
Solar Integration	40% by 2030	Achieved 35% in Dec 2024; pacing well	Low
Storage-Friendly Tariff	Yes	KERC pilot scheme; early stage	Moderate
Political Support	Cautious	State focused on coal transition; budgets stretched	Moderate
Overall Verdict	**Conditional**	**Supportive but constrained; execution-dependent**	**Moderate**

Rajasthan; constrained support (Hold)

Factor	Status	Evidence	Risk
DISCOM Support	Weak	RERC limits storage procurement; budget caps	High
Grid Frequency	Low	8 events Q3 - Q4 FY2024-25 (stable = low BESS upside)	High
Solar Integration	High	60% target; already 45%; surplus = low prices	High
Storage-Friendly Tariff	Conditional	RERC approves storage but with restrictions	Moderate
Political Support	Weak	Benefits from low-cost coal; storage deprioritized	High
Overall Verdict	**Hold**	**Regulatory constraints limit upside; wait for mandate**	**High**

6 Financing optimization & capital structure

6.1 Two-Tier Debt Structure (Recommended)

Current assumption: Simple amortizing debt at 6.50%, ₹518 Cr, 15-year tenor.
Optimized structure: Split into Tier-1 (senior) and Tier-2 (subordinated) for improved risk-adjusted returns.

Tier-1 Senior Debt (₹370 Cr = 50% capex)

- **Tenor:** 15 years
- **Coupon:** 6.00% p.a. (50 bps lower due to seniority)
- **Lenders:** Green development banks (ICICI, HDFC, iGate)
- **Security:** First mortgage on BESS + solar; subordinated PPA assignment
- **Covenant:** DSCR ≥ 1.5× (easily met; base case 10.3×)
- **Year-1 cost:** ₹370 Cr × 6.0% = ₹22.2 Cr

Tier-2 Subordinated Debt (₹148 Cr = 20% capex)

- **Tenor:** 12 years (shorter maturity)
- **Coupon:** 7.00% p.a.
- **Lenders:** Quasi-equity investors, insurance, impact funds, DFIs
- **Security:** Second mortgage; subordinated cash flow rights
- **Covenant:** DSCR ≥ 1.2× after senior debt service
- **Year-1 cost:** ₹148 Cr × 7.0% = ₹10.4 Cr

Blended Cost of Capital Improvement

Structure	Year-1 Interest	Total 15-Yr Interest	Blended Rate	Savings
Current model	₹33.67 Cr	₹261.3 Cr	6.50%	-
Two-tier optimized	₹32.6 Cr	₹247.5 Cr	**6.13%**	**₹13.8 Cr**

6.2 Green Bond / Sustainability-Linked Refinancing (Years 5–7)

Opportunity: After 2–3 years operational, refinance Tier-2 debt via capital markets.

Mechanics:

- **Instrument:** 10-year sustainability-linked bond
- **Timing:** Year 5–6 post-operational (de-risking complete)
- **Size:** ₹150–250 Cr (refinance Tier-2 subordinated debt)
- **Pricing:** 5.75–6.25% (50–75 bps cheaper than bank debt)
- **Investors:** Insurance, pension funds, sovereign wealth, impact funds

Performance triggers:

- 99%+ asset availability
- 100+ GWh cumulative annual storage
- Measurable grid carbon intensity reduction

Benefits:

- **Cost savings:** 50–75 bps reduction = ₹8–12 Cr NPV upside
- **Refinancing risk reduction:** Capital markets vs. single lender
- **Market liquidity:** Bond investors can exit pre-maturity
- **ESG credibility:** Demonstrates sustainability commitment

Viability: Expected BBB-/Baa3 rating by FY2027-28 (investment-grade); green bond market eager to fund operational BESS assets.

7 Merchant BESS market competitiveness

7.1 Competitive positioning vs. alternatives

LCOS (Levelized Cost of Storage) Benchmarking

Technology / Project Type	4-Hour LCOS (₹/MWh)	2026 India Range	Competitiveness
LFP BESS (Merchant)	₹68–85	₹75–95	Cost-competitive
LFP BESS (Regulated)	₹68–85	₹75–95	Strongly preferred
Gas Peaker (50 MW CCGT)	₹110–145	₹120–155	BESS now preferred
Hydro Pumped Storage	₹55–70	—	Lower cost; geographic constraints
Flow Battery (Vanadium)	₹150–200	₹160–220	Much higher cost; niche use
Thermal Storage + Solar	₹90–120	₹100–135	Higher; more complex

Key insight
BESS LCOS (₹75–95/MWh) now cheaper than gas peakers (₹120–155/MWh) and most alternatives. Economic preference clear.

7.2 Competitive Dynamics & Market Share Estimates

India's merchant BESS market is consolidating around 3–4 dominant players with multiple emerging challengers.

Competitive landscape (2025-26)

Player Type	Market Share	Revenue Model	Strategic Focus
Large Conglomerates (Adani, Reliance, NTPC)	40–45%	Multi-stream optimization	Scale; financing access; grid integration
Renewable Developers (GREEF, Sterling, Azure)	25–30%	Solar-bundled (paired storage)	Integration with solar; cost synergies
Pure BESS Specialists (Goodenough, others)	15–20%	Merchant + DISCOM contracts	Operational excellence; revenue stacking
Global Entrants (Tesla, BYD local, Fluence)	5–10%	Technology-led (software, AI)	Ancillary optimization; data analytics

Goodenough positioning: Pure-play specialist with focus on merchant revenue stacking and operational excellence. Competitive advantages:
- Superior ancillary services capture (AI-optimized SRAS accuracy)
- DISCOM relationship management (long-term volume expansion)
- Regulatory navigation expertise
- Financing access (green bond refinancing readiness)

Market opportunity: First-mover specialist advantage material through 2027; market commoditizes post-2028 as conglomerates dominate scale.

8 Three - project execution roadmap

8.1 Phased Deployment with Gating Criteria

Three projects cannot execute simultaneously. Phased approach with clear decision gates:

Phase 1: Maharastra (Immediate Greenlight)

- **Capex:** ₹740 Cr
- **Timeline:** FY2025-26 to Apr 2027 COD (24 months)
- **Expected IRR:** 21.8% (post-mitigation)
- **Risk level:** LOW

Go decision: Approve now
- Financing closure target: Q3 FY2026
- CERC registration: Concurrent with construction
- Supplier contracts: Locked by Jun 2025

Phase 2: Karnataka (Conditional, Month 18 Gate)

Capex: ₹740 Cr
Timeline: FY2026-27 to Apr 2028 COD
Expected IRR: 16.8–18.0%
Risk level: Moderate

Gating criteria (Month 18 reassessment):
- Maharashtra financial close achieved (Month 6–8)
- Maharashtra construction 90%+ on schedule
- DAM spreads sustain >₹3.50/kWh average
- KERC tariff framework published
- Goodenough operational track record proven

If gate not met:
- Option A: Reduce capex (25 MW vs. 50 MW; 2-hour vs. 4-hour)
- Option B: Defer to Year 4
- Option C: Reallocate to second Maharashtra site

Phase 3: Rajasthan (Hold, Month 24 Reassessment)

Capex: ₹740 Cr
Timeline: FY2027-28+ (conditional)
Expected IRR: 15.2% baseline -> 17%+ (if mandate + RERC support)
Risk level: High

Gating criteria (Month 24):
- CERC storage mandate finalized
- RERC tariff framework published
- DAM spreads improve to ₹4.00+/kWh
- Market supports ₹10+/kWh fixed-price contracts

If gate not met:
- Deprioritize Rajasthan
- Reallocate ₹740 Cr to:
  - -Second Maharashtra site (19.5% IRR)
  - -Gujarat / Andhra Pradesh (better spreads ₹3.80–4.20/kWh)
  - -Adjacent businesses (green hydrogen, EV charging)

8.2 Organizational Capability Building Timeline

Core Team Hires (Q2–Q3 FY2026)

Role	Timeline	Responsibility
BESS Operations Director	Apr 2025	Grid integration, battery management, safety
Grid Trading Manager	Jun 2025	IEX DAM, SRAS bidding, price optimization
Supply Chain Manager	Apr 2025	Long-term contracts, procurement, QA
Project Finance Manager	Jul 2025	Debt syndication, refinancing, green bonds
Regulatory Lead	Aug 2025	CERC tracking, state interface, compliance

Capability milestones:

- **Q1 FY2026:** In-house trading algorithm deployed
- **Q2 FY2026:** CERC SRAS registration completed
- **Q3 FY2026:** Financing closure achieved
- **Q4 FY2026:** Equipment orders placed with locked-in cell supplier

9 Risk summary & mitigation matrix

9.1 Key Risk Assessment

Risk Category	Probability	Frequency	Mitigation	Residual Risk
Spread Compression (DAM <₹7/kWh)	Medium (35%)	High (−₹150+ Cr NPV)	Hedging collar; DISCOM expansion	Medium-Low
Cell Supply Delay (6–12 mo)	Medium-High (40%)	Very High (₹60–80 Cr Y1 loss)	Long-term contracts; JV; backup supplier	Low
SRAS Event Decline (<10/yr)	Low (15%)	Medium (−₹40 Cr revenue)	Diversify to DISCOM; capacity contracts	Low
Regulatory Framework Change	Low-Medium (25%)	Medium (−₹30–50 Cr NPV)	Political engagement; diversified geography	Low-Medium
Financing Cost Escalation	Low (20%)	Medium (−₹20 Cr NPV)	Green bond refinancing; long-term locks	Low
Operational Availability Issue	Very Low (5%)	Medium (−₹50 Cr revenue)	Redundancy design; preventive O&M	Very Low
Technology Obsolescence (BESS)	Very Low (5%)	Low-Medium (₹0–50 Cr)	Mid-life refresh planning; tech reserve	Very Low

Overall risk profile: Moderate, manageable with disciplined execution and strategic hedging.

10 Sensitivity analysis & scenarios

10.1 IRR Sensitivity: Key Value Drivers

Parameter	Base Case	+10%	−10%	IRR Impact
Equipment Cost	₹2.80 Cr/MW	₹2.52	₹3.08	±0.4% IRR
DAM Spread	₹9.50/kWh	₹10.45	₹8.55	±0.8% IRR
Operational Availability	300 days/yr	330	270	±0.7% IRR
SRAS Events	150 events/yr	165	135	±0.5% IRR
WACC	7.25%	7.98%	6.53%	±0.9% IRR

Key insight

Project IRR most sensitive to DAM spreads (±0.8% per 10% change) and WACC (±0.9% per 100 bps change). Capital cost relatively insensitive (±0.4% per 10% change).

10.2 Scenario Analysis

Scenario A: Bull Case (All Factors Favorable)

Assumption	Value	Rationale
Equipment Cost	₹2.40 Cr/MW	Cost deflation accelerates
DAM Spread	₹10.50/kWh	Renewable oversupply mild; demand strong
SRAS Events	180 events/yr	Grid stress elevated; climate impact
DISCOM Volume	10 MW expansion by Yr 5	MSEDCL coal shortage acute
WACC	6.75%	Green bond refinancing achieved

Result: Bull Case IRR = 24.2% (vs. 19.5% base)

Scenario B: Base Case

Base case as modeled: 19.5% IRR

Scenario C: Bear Case (Adverse Factors)

Assumption	Value	Rationale
Equipment Cost	₹3.20 Cr/MW	Supply bottleneck; tariff escalation
DAM Spread	₹8.00/kWh	Renewable oversupply; low demand
SRAS Events	120 events/yr	Grid stabilization via other means
DISCOM Volume	No expansion	Budget constraints limit MSEDCL offtake
WACC	8.00%	Financing tightening; lender hesitancy

Result: Bear Case IRR = 10.5% (vs. 12.8% downside base)

Mitigation impact: With all three tiers (hedging, DISCOM expansion, AI optimization), bear case improves to 12.5–13.5%, materially strengthening downside resilience.

11 Investment decision framework

11.1 Final Board Recommendation (Goodenough Energy)

Maharashtra (Phase 1): Greenlight immediately

Approved:
- ₹740 Cr capex + ₹20–25 Cr mitigation spend
- Two-tier debt financing (₹370 Cr senior + ₹148 Cr sub)
- 30% equity stake (₹222 Cr) from Goodenough + co-investors

Expected returns:
- **Equity IRR:** 21.8% (post-mitigation)
- **Downside IRR:** 14.5% (with hedging + DISCOM expansion + AI optimization)
- **NPV @ 10%:** ₹1,033 Cr
- **DSCR (Y1):** 10.8×

Timeline:
- Land acquisition: Apr–Jun 2025
- Financing closure: Q3 FY2026
- Construction: Oct 2025–Feb 2027
- COD: Apr 2027
- Revenue ramp: ₹981 Cr Y1, stabilizing to ₹950–1,000 Cr Yr 5+

Rationale:
- Market timing optimal (equipment costs declining, financing available, regulatory support strengthening)
- Economics compelling (21.8% IRR exceeds 18% hurdle; 14.5% downside acceptable)

- Replication pathway proven (template for 3–5 additional sites nationally)
- Risk mitigated (hedging, volume diversification, ancillary optimization)

Karnataka (Phase 2): Conditional (Month 18 Gate)

Authorized:
- ₹15 Cr pre-development capex (land options, engineering, regulatory navigation)
- Final greenlight decision at Month 18 based on:
  - -Maharashtra financial close and construction progress
  - -DAM spreads sustain >₹3.50/kWh
  - -KERC tariff framework published

Expected returns (if gate met):
- **Equity IRR:** 17.0–18.0% (with volume optimization)
- **Downside IRR:** 11.5–12.5%
- **Risk level:** MODERATE (higher than Maharashtra but manageable)

If gate not met:
- Reallocate ₹740 Cr to second Maharashtra site or geographic alternative

Rajasthan (Phase 3): Hold (Reassessment Month 24)

Authorized:
- ₹5–10 Cr limited pre-development capex only
- No full financing or construction commitment

Reassessment gate at Month 24 (Q4 FY2027):
- CERC storage mandate must be finalized
- RERC tariff framework must be published
- DAM spreads must improve to ₹4.00+/kWh
- Fixed-price contracts must be achievable at ₹10+/kWh

If conditions met: Greenlight ₹740 Cr capex
If conditions not met: Deprioritize; reallocate to Maharashtra replication or geographic pivot

11.2 Capital Allocation & Financial Targets

3-Year Capital Deployment Plan (2025–2027)

Phase	Project	Year	Capex (₹ Cr)	Cumulative	Financing Closure
Phase 1	Maharashtra	FY2026	₹740	₹740	Q3 FY2026
Phase 2	Karnataka (conditional)	FY2027	₹740	₹1,480	Q1 FY2027 (if gate met)
Phase 3	Rajasthan (hold)	FY2028+	₹740	₹2,220	Conditional (Month 24 gate)

Blended Portfolio Returns (All Phases, Assuming Execution)

Metric	Phase 1 Only	Phase 1+2	Phase 1+2+3
Total Capex	₹740 Cr	₹1,480 Cr	₹2,220 Cr
Blended IRR (base)	19.5%	18.2%	17.3%
Blended IRR (optimized)	21.8%	20.1%	18.8%
NPV @ 10%	₹951 Cr	₹1,572 Cr	₹1,961 Cr
Cumulative 25-yr FCF	₹4,905 Cr	₹8,567 Cr	₹12,054 Cr
Risk Level	LOW	MODERATE	HIGH

Strategic insight

Phase 1 (Maharashtra) is low-risk, high-return flagship. Phase 2 (Karnataka) acceptable risk if Phase 1 succeeds. Phase 3 (Rajasthan) should be deferred pending regulatory clarity.

Conclusion & strategic implications

India's merchant BESS market has matured from pilot phase (2020–2023) to commercial deployment phase (2024–2025) to scaling phase (2026+). Goodenough Energy is positioned to lead pure-play BESS specialization with three competitive advantages:

- **Operational Excellence:** AI-optimized ancillary services capture (vs. merchant-only peers)
- **Revenue Stacking:** Multi-stream optimization (arbitrage + DISCOM contracts + grid services) delivering 20%+ returns
- **Regulatory Navigation:** State-level relationship management enabling long-term tariff expansion

Market timing is optimal. Equipment costs declining 20–22% annually through 2027; financing markets maturing (green bonds emerging); regulatory frameworks clarifying (CERC mandates, state tariffs). Capital deployed in 2026 achieves superior returns (20%+ IRR) vs. 2027+ (15–17% as competition increases).

Capital allocation strategy:

- **PHASE 1 (Maharashtra):** Greenlight immediately; ₹740 Cr capex; 21.8% IRR post-mitigation
- **PHASE 2 (Karnataka):** Prepare in parallel; final decision at Month 18; 17–18% IRR if economics hold
- **PHASE 3 (Rajasthan):** Hold; reassess Month 24 pending CERC mandate finalization

Expected portfolio impact (25-year horizon):

- ₹4,905 Cr cumulative FCF (Maharashtra Phase 1 only)
- ₹951 Cr NPV @ 10% discount rate
- 19.5% equity IRR base case; 21.8% optimized; 12.8% downside resilient

Execution on this roadmap positions Goodenough as India's leading pure-play BESS operator with 3–5 GW deployed capacity and ₹15,000+ Cr enterprise value by 2030.

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Disclaimer: This whitepaper presents financial frameworks and operational insights based on 2024–2025 market data and Goodenough Energy's proprietary modeling. Project-specific economics should incorporate detailed engineering assessments, legal reviews, site-specific resource analysis, and updated market conditions. Past performance and historical benchmarks do not guarantee future results. Regulatory frameworks and technology costs are subject to rapid change in India's evolving energy storage market.

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