

Energy Efficiency in Food Manufacturing

Dairy | Beverages | Packed Food

Integrated Case Study: CMIL Greater Noida, Food Manufacturing Company



Executive summary

India's food processing sector is expanding rapidly in capacity and complexity, driven by cold-chain investments, export-grade processing, and rising domestic consumption of dairy, beverages, and packaged foods. As plants shift to 24/7 operations with higher automation, energy costs, power quality, and outage risks increasingly determine profitability and product quality.

Yet the energy infrastructure serving this sector has not matured at the same pace. Grid tariffs continue to escalate, time-of-day price differentials penalize peak-hour consumption, and diesel generation costs remain **2.5–3.5×** higher than grid electricity. Frequent power disruptions in industrial regions force manufacturers to rely on slow, inefficient DG sets, causing production interruptions, spoilage risk, and unplanned maintenance costs.

Battery Energy Storage Systems (BESS) have emerged as a central solution for this multi-dimensional energy challenge. Industrial BESS, typically based on advanced lithium-ion chemistries such as LFP, provide **90–95%** round-trip efficiency and 6,000–10,000 charge-discharge cycles, translating into **15–25 years** of operational life.

The **Greater Noida case study** where CMIL, a leading malted food and dairy ingredient manufacturer, partnered with GoodEnough Energy to install a 2 MWh BESS - demonstrates that energy storage can simultaneously:

1

Reduce costs by ₹3–4 Crores annually

2

Eliminate diesel dependence

3

Ensure uninterrupted production

4

Unlock access to green-compliance-sensitive export markets

BESS = Cost + Reliability + sustainable solution



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01

The rapid growth of food manufacturing in India

India's food manufacturing sector is undergoing structural expansion, positioning itself as a global hub for processed foods, dairy, and beverages. Capacity additions in cold-chain logistics, integrated dairy plants, beverage bottling units, and packaged food factories are reshaping the industrial landscape[1].

Sector characteristics:

Dairy: Large-scale chilling centres, pasteurization lines, spray drying facilities with high energy intensity per tonne

Beverages: High-speed bottling lines, carbonation systems, refrigeration creating sharp load swings

Packaged Foods: Automated frying, baking, extrusion, freezing processes raising peak power requirements

However, energy infrastructure has not scaled at the same pace as production intensity. While this industrial growth is positive for the economy, energy infrastructure - both at grid level and within factories - has not scaled proportionately[2].

Manufacturers are facing three critical energy problems:

Cost Crisis



Tariff escalation, peak penalties, diesel costs

Reliability Crisis



Power disruptions impacting production continuity

Sustainability Mandates



Carbon compliance and renewable pressure.

02

Three critical energy Problems

2.1 Cost crisis

Energy is among the top operating costs. Industrial tariffs have been increasing steadily, with states such as Uttar Pradesh charging commercial and industrial consumers more than ₹8 per kVAh, alongside significant fixed demand charges[3].

Sub-sector cost impact analysis

Sub-Sector	Avg. Monthly Electricity Bill	% Cost Increase Due to DG + Grid Reliance	Industry Size Impact
Dairy	₹40–70 Lakhs	22–30%	Highest impact on medium & large plants
Beverages	₹35–60 Lakhs	18–26%	High impact due to bottling & chilling loads
Packed Food	₹20–45 Lakhs	12–20%	Moderate impact; higher on small units

Table 1: Energy cost impact by food manufacturing sub-sector

Key cost drivers:

- Rising industrial tariffs (4–7% annual increases)
- Peak demand charges penalizing instantaneous high kVA draw
- Time-of-Day pricing with 25–40% premiums during peak hours
- Diesel backup at ₹20–25 per kWh (2.5–3.5× grid cost)
- Billing volatility due to production variations

5-year outlook: A plant spending ₹50 Lakhs per month on electricity today could see bills rise to ₹60–70 Lakhs over the next five years, even before accounting for increased production[4].



2.2 Reliability crisis

Power reliability is foundational in food manufacturing, where many processes are continuous and temperature-sensitive. Grid reliability in many industrial clusters is insufficient to support 24/7 food operations without frequent recourse to diesel generators[5].

Key drivers:

- **Switching time:** Several minutes of downtime during DG startup, causing production stalls and quality risks
- **Fuel cost:** Levelized cost exceeding ₹20–25 per kWh; yearly diesel bills of ₹50–70 Lakhs+ for frequent outages
- **Maintenance:** Accelerated service schedules, recurring costs, unexpected failures
- **Load handling:** Undersized or part-load operation causing voltage drops, frequency instability



2.3 Sustainability mandates

Food manufacturers face tightening sustainability requirements from both regulatory and market forces[7].

Key drivers:

- **Export compliance:** EU Carbon Border Adjustment Mechanism (CBAM) imposing tariffs on high-emission imports
- **Retailer procurement standards:** ESG and renewable energy criteria in supplier selection
- **Scope-2 emission reporting:** BRSR norms requiring disclosure of purchased electricity emissions
- **Renewable Purchase Obligations (RPO):** Mandated minimum renewable energy procurement with penalties for non-compliance

Adoption gap: Solar PV installations are common, but without storage, solar generation is intermittent and mismatched to 24/7 operations. Many plants cannot fully utilize potential solar generation due to production schedules and grid constraints[8].

BESS fills this gap by storing excess solar generation and releasing it when needed, converting variable renewable resources into firm, dispatchable power[9].

03

Energy implications in India's food manufacturing sector

India's food manufacturing sector is undergoing rapid expansion driven by automation, cold-chain investments, and export-grade processing upgrades. Capacity additions across dairy, beverages, and packaged foods are significantly increasing connected loads, operational complexity, and energy intensity across facilities

3.1 Energy intensity by sub-sector

Dairy facilities: Very high energy intensity with major loads including refrigeration for milk chilling and cold storage, thermal energy for pasteurization and sterilization, electrical loads for spray drying. Estimated sector energy consumption at 0.29 million MTOE with strong upward trajectory[10].

Beverages: Highly energy-intensive with carbonation, bottling, cleaning-in-place systems, and refrigeration dominating the load profile[11].

Packed food facilities: Moderate to high energy intensity depending on extent of frying, baking, extrusion, and freezing used in production[12].

Sub-Sector	Electrical Dependency	Backup Reliance	Renewable Adoption Trend
Dairy Processing	Very High (continuous refrigeration + spray drying)	High (DG critical for chilling continuity)	Strong rooftop + biomass boiler integration
Beverages (Carbonated / Bottling)	High	Moderate	Increasing open-access solar adoption
Packaged & Frozen Foods	Moderate-High	Moderate	Gradual solar + energy storage adoption

Table 2: Typical energy mix in food manufacturing facilities

Infrastructure gaps: Vulnerability to grid outages, exposure to rising tariffs and ToD charges, limited capability to optimize energy consumption during peak periods. Many facilities lack advanced power management systems or storage[13].

Key Insight: As food manufacturing scales, energy systems are becoming more load-intensive, peak-sensitive, and reliability, critical in creating a growing need for structured power management and resilience solutions



04

BESS - The solution

Core capabilities of Battery Energy Storage Systems

Battery Energy Storage Systems offer a comprehensive response to the cost, reliability, and sustainability challenges. Rather than treating electricity as a fixed cost and passive input, BESS enables plants to actively manage when and how they consume energy[14].

Key capabilities:

- **Instant Outage Backup:** Detects grid disturbances and transitions to battery power within milliseconds, providing seamless backup without DG startup delay
- **Peak Load Shaving:** Discharges during demand spikes, reducing maximum kVA recorded in billing cycle and lowering demand charges
- **Energy Arbitrage:** Charges during off-peak tariff periods or when solar output is abundant; discharges during peak tariff windows
- **Power Quality Stabilization:** Provides voltage and frequency regulation, reactive power support, harmonic filtering
- **DG Runtime Reduction:** Reduces or eliminates diesel generator reliance for most scenarios

Technical characteristics:

- **Chemistry:** Lithium-ion (LFP-lithium iron phosphate) known for high safety and long cycle life
- **Efficiency:** 90–95% round-trip (only 5–10% energy loss)
- **Lifespan:** 15–25 years of operation with appropriate depth-of-discharge and cycling patterns
- **Cycles:** 6,000–10,000 charge-discharge cycles
- **Modularity:** Scalable from hundreds of kWh to multiple MWh by combining standardized units



4.1 Daily operation cycle

4.1.1 Solar + BESS Integration

The combined operation of solar and BESS enables food manufacturing facilities to orchestrate a daily energy strategy that minimizes costs, maximizes renewable utilization, and ensures round-the-clock reliability[15].

Daily charge-discharge schedule:

Time Period	Operation
10 PM – 6 AM	Off-Peak Charging: BESS charges during low tariff periods (₹6–7/kWh), drawing power when grid has available capacity
6 AM – 10 PM	Discharge for Operations: BESS discharges to support production, reducing net grid power during higher tariff periods (saving ₹3–6/kWh)
Solar Hours	Store Excess Solar: BESS stores surplus midday solar generation instead of curtailing, increasing solar utilization from 50–60% to 85–95%
Grid Outage	Instant Seamless Backup: BESS immediately takes over, providing uninterrupted power without DG startup

Table 3: Daily BESS operation cycle integrated with solar

4.1.2 Solar + BESS Synergy

The synergy between solar and storage lies in decoupling the timing of energy generation from energy use. Solar energy generated during the day can be stored and deployed during evening peaks or overnight refrigeration loads, aligning renewable production with operational demand[16].

Operational outcomes:

- Solar utilization increases to 85–95% by capturing and using energy that would otherwise be curtailed
- Peak tariff procurement minimized as BESS supplies power during expensive hours
- Diesel backup displaced in most outage scenarios, drastically reducing fuel costs and emissions
- Continuous, clean power availability supporting operational resilience and sustainability goals

4.2 Economics of BESS deployment

4.2.1. Savings streams explained

To justify investment in BESS, food manufacturers evaluate the levelized cost of storage (LCOS) and multiple streams of savings it enables[17].

Six primary savings streams:

- **Peak Demand Reduction:** Shaving peaks lowers maximum kVA recorded, reducing demand charges (tens of lakhs annually for medium-large plants)
- **Energy Arbitrage:** Shifting load from ₹10–12/kWh peak tariffs to ₹6–7/kWh off-peak equivalents yields ₹60–75 Lakhs+ annual savings
- **Diesel Cost Avoidance:** Eliminating diesel at ₹28–30/kWh can save ₹50–70 Lakhs+ annually
- **Maintenance Savings:** Reduced DG runtime cuts service intervals and wear, saving ₹15–20 Lakhs per year
- **Spoilage Prevention:** Avoiding product spoilage and batch losses can save ₹50–80 Lakhs annually in dairy and cold-chain facilities
- **Downtime Reduction:** Ensuring smooth power supply reduces lost production and missed deadlines, saving ₹40–50 Lakhs per year

4.2.2. Annual Savings (proposed)

If a facility adopts 2 MWh StorEDGE BESS, their proposed annual savings shall be:

Savings Category	Annual Amount (₹ Lakhs)
Peak Demand Reduction	80–90
Energy Arbitrage	60–75
Diesel Savings	50–70
DG Maintenance	15–20
Spoilage Reduction	50–80
Downtime Avoidance	40–50
Total Annual Savings	₹3–4 Crores

Table 4: Annual savings breakdown for 2 MWh BESS deployment

Payback period: Under 3 years with high internal rate of return[19].

05

Case study: Greater noida food manufacturing facility

Facility profile

CMIL's Greater Noida facility is a prominent manufacturer of malt-based drinks, cereals, and dairy ingredients supplying national brands and institutional programs. The facility operates a 24/7 processing setup with spray drying, extrusion, and roasting lines[19].

Pre-BESS challenges

- 5–6 outage hours per month with frequent disturbances during peak demand seasons
- Heavy reliance on diesel generators to maintain production, resulting in high fuel and maintenance costs
- Refrigeration and batch processing risks during outages, raising spoilage and quality degradation possibilities
- Significant exposure to peak tariffs and demand charges given energy intensity of spray drying and extrusion
- Voltage fluctuations affecting sensitive equipment and occasionally causing nuisance trips or production stoppages

BESS deployment

GoodEnough Energy partnered with CMIL to deploy a 2 MWh BESS system based on liquid-cooled lithium-ion technology, comprising eight 250 kWh units distributed near key loads[20].

System design objectives:

- Provide instantaneous outage backup for critical operations, eliminating production interruptions for typical grid failures
- Enable peak shaving by discharging during high-demand intervals while charging during off-peak hours

- Provide instantaneous outage backup for critical operations, eliminating production interruptions for typical grid failures
- Enable peak shaving by discharging during high-demand intervals while charging during off-peak hours

Post-deployment outcomes

Following deployment, the plant reported:

- Near-zero reliance on DG for routine outages
- Reduced demand charges and lower average energy costs through arbitrage
- Improved process continuity and reduced spoilage risk
- Enhanced green manufacturing credentials supporting access to export markets in UK, US, and other regions

Financial impact

- Annual savings: **₹3-4 Crores**
- Turnover impact: **5-7% improvement** when considering plant's revenue base
- Lifetime value: Over **25-year asset life**, potential losses prevented or costs saved estimated at **₹90-150 Crores**



5.1 Other successful BESS deployments in Indian food manufacturing

5.1.1 Dairy plant in Maharashtra - Peak Demand Optimization

Location: Industrial zone under Maharashtra State Electricity Distribution Co. Ltd. (MSEDCL) jurisdiction

Purpose: Peak demand reduction, load management, grid stability

Type: Behind-the-meter BESS for industrial optimization

System: Part of 300 MW/600 MWh pilot; Li-ion with BMS; medium voltage network integration; BOO under BESPA

Impact: 32% peak demand charge reduction; ₹80–100 Lakhs annual savings; dairy process stability



5.1.2 Cold storage facility in Gujarat - Refrigeration continuity

Location: Gujarat industrial/agricultural cold chain corridor

Purpose: Uninterrupted refrigeration, spoilage prevention

Type: Mission-critical backup for 24/7 operations

System: 500 kWh–2 MWh LFP; liquid-cooled; IoT EMS; compressor/freezer integration

Impact: Zero spoilage; 90%+ DG reduction (₹40–60 Lakhs saved); 100% refrigeration uptime



5.1.3 Beverage Plant in Karnataka - Demand charge management

Location: KREDL industrial zone

Purpose: Peak load management, renewable integration

Type: Hybrid solar+BESS for bottling operations

System: 1–3 MWh with 2–5 MW solar; NMC/LFP; 2-hr discharge; KPTCL grid islanding

Impact: 25–35% demand reduction (₹60–80 Lakhs saved); 80–90% solar utilization; <4 yr payback



5.2 Global deployment

5.2.1 Nestlé - Texas, USA (Stampede Solar+Storage)

Purpose: Grid optimization, renewable procurement

System: 326 MW solar + 86 MW/172 MWh BESS; ERCOT grid; Nestlé PPA

Impact: Frequency regulation revenue; 24/7 clean power; net-zero progress



5.2.2 Danone - Wexford, Ireland (Carbon neutral plant)

Purpose: Certified carbon neutrality

System: 100% RE + biomass + BESS; ISO 50001 EMS

Impact: 70% CO₂ reduction; world's first carbon-neutral infant formula plant



06

Policy and ecosystem support

6.1 Government policy enablers

India's policy framework strongly supports the deployment of energy storage, both at grid scale and behind-the-meter in industrial settings[22].

Key policy initiatives:

- **National Energy Storage Mission:** Accelerating domestic manufacturing of advanced batteries and integration into power systems
- **PLI Scheme for Advanced Chemistry Cells (ACC):** ₹18,100 Crores outlay targeting creation of **50 GWh domestic ACC** manufacturing capacity
- **Accelerated depreciation benefits:** For renewable-plus-storage assets improving project returns and shortening payback periods
- **State-level incentives:** Various states offering incentives for hybrid (solar + storage) projects

6.2 Financing support

Industrial energy storage projects can access:

- Green infrastructure funds
- Climate investment platforms
- Development finance institutions
- Energy-as-a-Service (EaaS) providers offering storage capacity under pay-per-use or OPEX model

EaaS models allow food manufacturers to benefit from BESS without heavy upfront capex, instead paying from realized savings[23].

6.3 Regulatory evolution

Regulators are gradually recognizing storage as a distinct asset class:

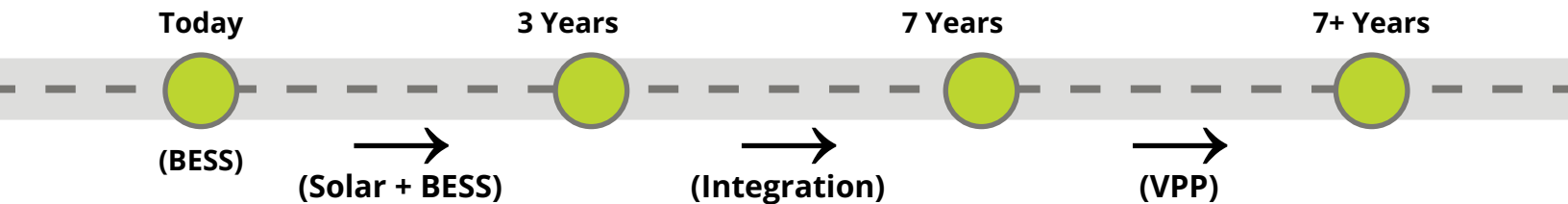
- Clarifying regulatory status of behind-the-meter storage

- Allowing storage to participate in ancillary service markets and grid support roles
- Facilitating hybrid renewable-storage interconnections

These developments signal long-term institutional support for storage adoption in industrial sectors like food processing, reducing regulatory risk for early movers[25].

07

Future roadmap and industry leadership



Energy transition pathway

The energy evolution of India's food manufacturing sector can be viewed as a phased journey:

Near Term (0–3 years):

- Manufacturers prioritize diesel reduction and peak cost optimization by deploying stand alone BESS systems
- Immediate focus on reducing DG dependence, shaving peaks, exploiting ToD arbitrage to lower bills

Mid Term (3–7 years):

- Solar integration with storage becomes standard
- Plants install or expand rooftop and ground-mounted solar, using BESS to store excess generation and provide firm power
- Renewable contributions to plant energy rise significantly, allowing meaningful Scope-2 emission reductions

Long Term (7+ years):

- Facilities transition toward fully integrated energy ecosystems combining storage, renewables, intelligent load management, dynamic grid interaction
- Advanced energy management systems coordinate process loads, storage, and external markets
- Potential participation in virtual power plant (VPP) models, providing grid services and earning revenue

08

GoodEnough Energy: Enabling the transition

GoodEnough Energy operates one of India's most advanced BESS manufacturing and integration platforms, supplying industrial-scale battery storage systems tailored for sectors such as dairy, beverages, and packaged food[26].

Capabilities:

- System design and cell-to-system integration
- Power electronics and energy management software
- End-to-end project execution
- Designing BESS architectures matching 24/7 processing plant load profiles
- Engineering solar-plus-storage solutions maximizing renewable energy utilization
- Implementing peak demand optimization and tariff arbitrage strategies
- Ensuring high reliability in outage-prone regions such as Delhi-NCR

By addressing diesel dependency, stabilizing power quality, and unlocking energy cost savings, GoodEnough Energy helps food manufacturers transition toward resilient and sustainable energy architectures supporting both growth and compliance[27].



Conclusion

India's food manufacturing sector stands at a critical juncture where energy infrastructure must evolve as rapidly as production capacity to sustain growth, competitiveness, and market access. The convergence of rising energy costs, unreliable grid supply, and stringent sustainability mandates has transformed energy from a passive operational input into a strategic determinant of business viability across dairy, beverages, and packed food sub-sectors.

Battery Energy Storage Systems represent more than an incremental upgrade - they constitute a foundational shift in how food manufacturers procure, manage, and deploy electrical power. By enabling peak shaving, energy arbitrage, seamless backup, power quality stabilization, and firm renewable integration, BESS addresses the full spectrum of energy challenges simultaneously rather than in isolation.

The Greater Noida case study, with documented annual savings of ₹3–4 Crores and projected lifetime value of ₹90–150 Crores, validates that storage is not merely a cost but an investment that generates compounding returns through multiple value streams - operational, financial, and strategic.

Moreover, the alignment of national policy frameworks - including the National Energy Storage Mission, PLI scheme for ACC manufacturing, accelerated depreciation for renewable-storage hybrids, and evolving regulatory recognition of behind-the-meter storage—creates an enabling ecosystem that reduces technology risk, improves financing accessibility, and signals long-term institutional support for industrial storage adoption.

The integration of storage today is not about addressing a temporary challenge - it is about positioning for a fundamentally different energy paradigm where 24/7 manufacturing operations run on optimized, decarbonized, resilient power systems that enhance rather than constrain competitiveness in both domestic and export markets.

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Disclaimer: This industry case study is based on 2024–2025 industry data, operational benchmarks, and GoodEnough Energy's analytical modeling and is intended for informational purposes only.

Actual outcomes may vary depending on plant configuration, automation levels, energy infrastructure, regulatory requirements, and site-specific operating conditions.

Financial projections and performance improvements are illustrative and should be validated through detailed technical and commercial assessments.

Technology costs, regulations, and market conditions may change over time. This document does not constitute financial, legal, or investment advice.

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