TOPTIER ENERGY SERVICES PVT LTD

How India’s Feed Mills Can Cut Energy Costs and Carbon Emissions

A practical guide for feed, oilseed and poultry businesses, with a three-scenario investment case.



Original AI-generated editorial illustration of a representative feed mill.

The hidden energy story

A feed mill can pay for the same tonne three times. First the hammer mill grinds it, then the pellet press compresses it, and finally the screen sends the fines back for another trip. Every pass consumes electricity, and every repeat can absorb steam and capacity on a line

already scheduled for two shifts. If the electricity bill rises, would buying more solar solve the problem, or would the mill save more by making a saleable pellet the first time?

Consider a production meeting at a hypothetical feed plant. The commercial team reports higher tonnage. Engineering reports higher electricity use. Both are right, but neither number shows whether the mill produced more saleable feed per unit of energy. Bring recipe, moisture, throughput, rejected pellets, motor loading and boiler fuel into the same daily report. Suddenly the conversation can distinguish growth from waste.

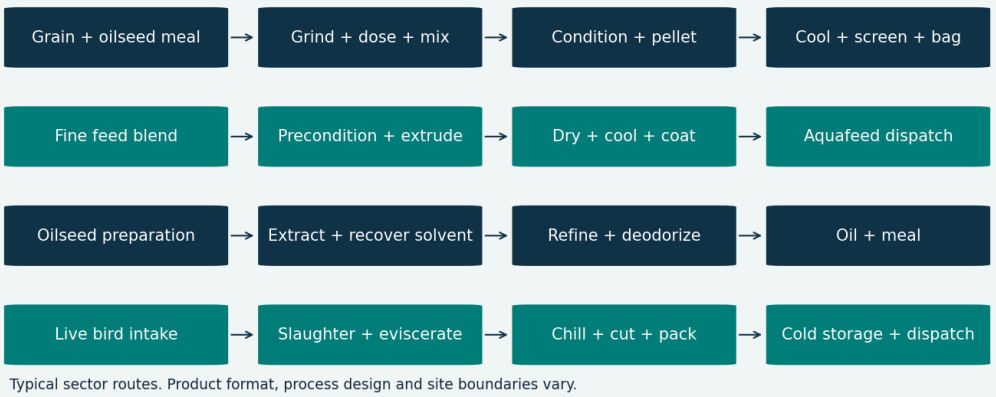
How the industry turns grain into feed, oil and protein

Compound feed begins with intake, cleaning and weighing. Maize and other grains supply energy, and soy meal and other protein meals supply amino acids. Premixes, minerals and fats are dosed to specification. After grinding and mixing, some products are sold as mash. Pellets need conditioning with steam, compression through a die, cooling, screening and bagging. Hammer mills and presses drive electric use. Air-handling loads can persist through idle time, and steam intensity can rise during starts, grade changes and short runs.

Extruded aquafeed adds a demanding moisture cycle. A preconditioner and extruder use moisture, steam and mechanical energy to shape the product. A dryer removes moisture to meet the storage specification. Cooling, oil coating and screening finish the product. Floating and sinking feeds impose different process requirements. Track kWh and fuel by recipe and tonne of accepted product. A low dryer setpoint that increases rejects, compromises shelf life or changes floatability is an expensive way to save heat.

Oilseed processing has a different utility profile. Seed preparation includes cleaning, size reduction or flaking and conditioning. Where solvent extraction is used, desolventization and solvent recovery drive thermal demand. Refining adds pumps, vacuum and heat for operations such as deodorization where applicable. Soy meal and oil share upstream burdens. Select and disclose a defensible co-product allocation method and test sensitivity to changes in the value of oil and meal. Solvent recovery improvements also merit attention for solvent loss and worker safety. VOC losses should be tracked separately from the GHG inventory unless the substance and reporting rules require an inventory entry. [1] [2]

Poultry processors should map electricity around chilling, freezing, cold rooms, water pumping and ventilation. Hot water supports sanitation and, where used, scalding. Differentiate controlled farms, contract growers and independent processing. Controlled farm ventilation, brooding heat, manure and owned transport can change the inventory materially. The poultry effluent treatment system may consume power for aeration and may emit methane or nitrous oxide depending on the treatment pathway. Keep food safety, water quality, feed quality and equipment safety constraints in every trial. [2]

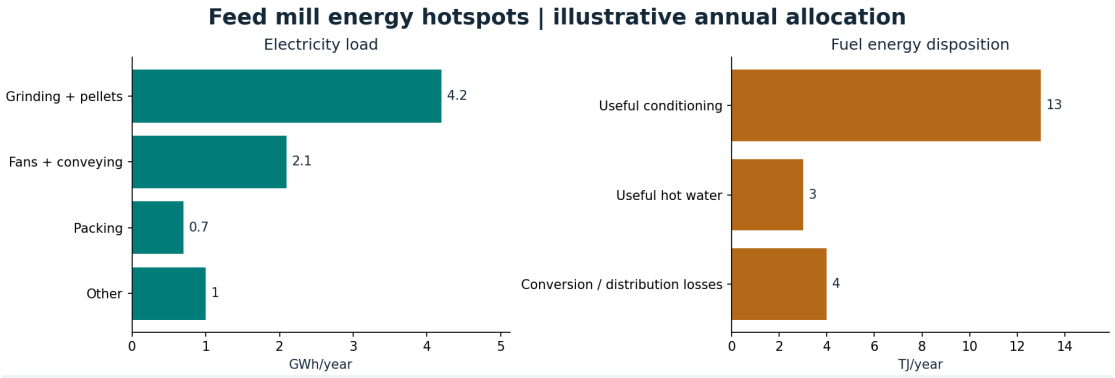


Typical process steps across four production routes.

Where the main energy losses sit

Start with four meters or meter groups. Separate grinding and pellet lines, fans and conveyors, the boiler fuel and steam system, and any common refrigeration plant. Record production by line and shift, wet and dry product basis where relevant, rework, boiler runtime, and ambient conditions. Compare operating data at similar throughput and product mix. A high kWh-per-tonne reading during startup can be a sequencing issue even if motor efficiency is excellent.

The European food-industry BAT reference reports an annual average compound-feed energy range of 0.01–0.10 MWh per tonne in its reference context. Pelleting, product mix, utilization and energy-system boundaries matter. Use that range to ask better questions and compare like-for-like. A plant with a large extruded aquafeed line, extensive drying or off-site utilities needs a separate baseline. The chart follows 20 TJ of fuel into 16 TJ of useful heat and 4 TJ of boiler and distribution losses. The modeled fuel gives 1,122 tCO_2 of direct combustion emissions. Electricity use of 8 GWh gives 5,816 tCO_2 for fully grid-supplied operation at the historical model factor. The illustrative allocation below uses 26.7 kWh of electricity per tonne plus 18.5 kWh-equivalent of fuel input per tonne. [1]



Illustrative inputs. Annual electricity totals 8 GWh and fuel energy totals 20 TJ.

What belongs in each emission scope

Scope 1 — owned or controlled sources

Start with boilers, dryers, diesel generators and owned fleet fuel. Reconcile fuel receipts and inventories against meter data and combustion factors. Where the company controls poultry production, screen manure handling and any relevant farm emission sources. Add refrigerant losses from service and recharge logs. Screen on-site wastewater for CH_4 and N_2O based on the process actually installed. Oilseed sites should maintain solvent records and separate greenhouse gas reporting from other environmental permit obligations. [2] [3] [7]

The first interventions are operational. Repair failed steam traps, recover clean condensate, verify boiler excess air and maintain insulation. Next, match the lowest-temperature demand to available waste heat. Heat pumps need a dependable source and sink, acceptable temperature lift, reliable sanitation and sufficient electrical headroom. An electric boiler can supply steam with simpler equipment integration, but its power cost and demand requirement can change the economics. Gas displacement by biomass or biogas merits a delivered-fuel, storage, air-emissions and lifecycle review. For biomass, report biogenic CO_2 as applicable and include relevant non-CO_2 combustion gases and upstream impacts. For biogas, test feedstock quantity, digestate handling and methane slip. Hydrogen requires a reliable supply and a competitive delivered heat cost before a plant commits capital.

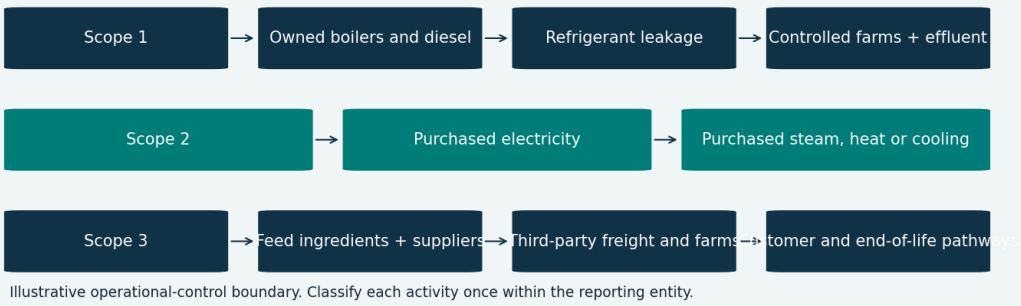
Scope 2 — purchased energy

Track purchased electricity and any purchased steam, heat or cooling. For location-based reporting, grid electricity uses a geographically relevant average factor. For market-based reporting, evaluate contractual instrument quality, geographic and vintage eligibility, exclusive ownership and retirement, and use the applicable

residual-mix or fallback factor for unmatched electricity. A PPA can deliver bill savings without transferring the attributes needed for a market-based claim. Similarly, a renewable certificate does not eliminate the grid energy charged on the bill. Verify who owns the attributes for rooftop generation, open-access supply and any captive plant before publishing claims. [4] [6]

Scope 3 — agriculture, transport and the rest of the value chain

Ingredient emissions can be substantial even where a mill operates efficiently. Crop growing conditions, fertilizer and soil emissions, distance travelled, production method, land-use change and oilseed co-product allocation can all affect the footprint of maize and meal. Ask suppliers for crop and origin, production period, data quality and calculation boundary. Where compatible screening data exist, move from spend estimates to physical quantity times regionally representative factors. Use comparable data boundaries when testing alternate recipes and validate animal performance, nutrient efficiency and feed safety before rollout. For suppliers, logistics partners and growers, make data exchange a contract deliverable that can be audited. [3] [5]



Assign each source using the adopted organizational boundary.

GHG Protocol category	Screening priority and ownership of action
1 Purchased goods and services	High. Crop, meal, premix, packaging and contracted services. Procurement controls specifications. Growers and suppliers provide origin, practice and emissions data.
2 Capital goods	Periodic. Engineering requests embodied carbon and useful-life data for major equipment and buildings.
3 Fuel- and energy-related activities	Relevant. Procurement collects upstream fuel/power and transmission loss data with consistent boundaries.
4 Upstream transport and distribution	Relevant. Include purchased transport, including purchased outbound freight where applicable. Logistics controls routes and load factors with carriers.
5 Waste generated in operations	Relevant. Record external treatment of sludge, rejects, packages and by-products with waste contractors.
6 Business travel	Usually lower. Capture booked trips and travel modes.
7 Employee commuting	Usually lower. Survey modes and distance. Evaluate shared transport.
8 Upstream leased assets	Conditional. Review leases outside Scopes 1 and 2 under the selected control boundary.
9 Downstream transport and distribution	Relevant. Estimate freight and storage beyond sale that the reporting company does not purchase. Engage distributors.
10 Processing of sold products	Conditional and potentially material. Screen processing of intermediate meal or crude oil, and downstream treatment of other intermediate products in line with the GHG Protocol boundary. Engage customers.

GHG Protocol category	Screening priority and ownership of action
11 Use of sold products	Conditional. Assess direct use-phase emissions and appropriate treatment of indirect use. Document feed and livestock value-chain treatment to avoid overlapping with processing or controlled farm emissions.
12 End-of-life treatment of sold products	Relevant for packaging and potentially discarded products. Model disposal channels by market.
13 Downstream leased assets	Conditional. Review assets leased out and outside the company's Scope 1 and 2 boundary.
14 Franchises	Conditional. Confirm whether franchises exist and fall outside Scope 1 and 2.
15 Investments	Conditional. Screen JVs and investments outside the selected consolidation boundary.

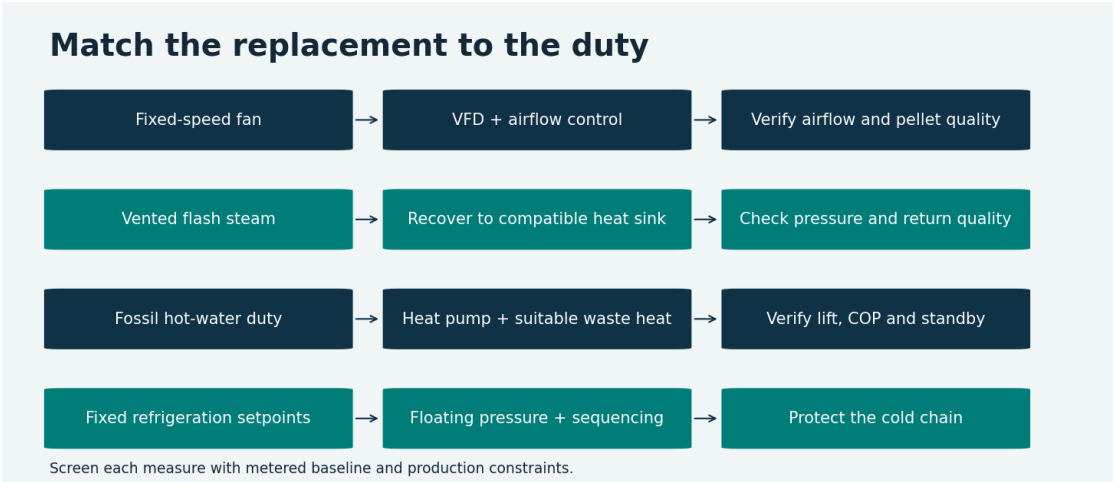
Compare plants by capability, not by labels

The conventional profile has a single utility meter, operates compressors and fans on fixed settings, and reconciles fuel costs after month-end. It has low implementation overhead and high exposure to waste, tariff shifts and unexplained changes in energy intensity. The transitioning profile uses line-level KPIs and operator routines, recovers condensate, sequences drives and procures a measured share of renewable electricity. It has a stronger understanding of whether savings hold through seasonal changes. The advanced profile optimizes heat and power together, validates product-specific footprints, negotiates energy-attribute terms and requests supplier activity data.

These are investment maturity profiles for self-assessment. A site can be advanced in steam recovery and still lack a reliable electricity procurement baseline. Another can have low-cost solar but a vulnerable night load. The cost of delay typically enters through avoidable variable charges, exposure to volatile fuel and ingredients, weaker supplier data, and future equipment retrofits that compete for downtime with production. Quantify these channels individually when preparing the board paper. An effective baseline lets the finance team ask what it will cost to wait one year and lets plant engineering say which downtime window is feasible.

Technology that respects product quality

Treat each technology proposal as a production trial. For pellet lines, log die wear, particle size, throughput and steam per tonne alongside pellet durability and fines. For aquafeed dryers, use controlled exhaust and moisture feedback with recipe- and size-specific limits. For refrigeration, test suction and condensing pressure changes under peak ambient conditions. Add low-temperature heat recovery where compressor performance, heat demand and food-safe heat exchange support it. Plant teams can trial many of these interventions on one line before replicating the change. [1] [2]



Examples of technology substitutions and checks before implementation.

Process and energy	Conventional loss and alternative	Savings and carbon screening	Indicative CAPEX	Maturity / priority / dependency
Grinding and pelleting | electrical	Idle running, worn screens and dies, repeat passes. Apply interlocks, sequencing and maintenance.	Target 3–8% of line kWh for screening. Scale tCO_2 using baseline line kWh and reporting factor.	₹5–35 lakh	Commercial / High / 0–6 months. Verify fineness, throughput and durability.
Conditioning and steam | thermal	Traps, blowdown, condensate and distribution loss. Repair and recover clean heat.	Target 5–12% of boiler fuel as a trial envelope. Direct reduction depends on fuel.	₹10–80 lakh	Commercial / High / 0–18 months. Check return quality and temperature.

Process and energy	Conventional loss and alternative	Savings and carbon screening	Indicative CAPEX	Maturity / priority / dependency
Extrusion drying | thermal and electric	Overdrying and exhaust loss. Add recipe controls, moisture feedback and heat recovery.	Target 5–15% of dryer fuel for screening. Check electricity changes.	₹25 lakh–₹2 crore	Commercial / High at extruders / 6–18 months. Confirm final moisture, durability and safety.
Oil extraction and refining | steam and electricity	Steam and condenser losses. Integrate compatible heat sinks and repair vacuum leaks.	Meter steam per tonne, solvent loss and yield. Savings depend on temperature pinch and uptime.	₹40 lakh–₹3 crore	Commercial / Medium / 6–36 months. Use isolation and solvent-safety design.
Refrigeration | electricity and refrigerants	Fixed pressures, air infiltration and leaks. Tune setpoints, sequence and recover heat.	Target 5–15% of refrigeration kWh as a screening range. Meter leaks separately.	₹15 lakh–₹1.5 crore	Commercial / High at cold sites / 6–18 months. Protect sanitation and cold chain.

Process and energy	Conventional loss and alternative	Savings and carbon screening	Indicative CAPEX	Maturity / priority / dependency
Low-temperature hot water | thermal to electrical	Fossil boiler. Recover waste heat and test industrial heat pump.	Assess useful heat ÷ seasonal COP and electricity price and carbon. Case COP 2.8.	₹0.75–4 crore	Commercial, application specific / Medium / 18–36 months. Verify duty, lift and reserve.
Power procurement | electricity	Grid exposure. Optimize rooftop and contracted solar-wind supply.	₹2.80/kWh modeled OA spread before timing sensitivity. Market-based carbon claim depends on attributes.	₹3–5 crore per MWp rooftop screening assumption. OA equity/fees vary.	Commercial / High / 6–18 months. Confirm roof, settlement and terms.
Supplier ingredients and logistics | upstream	Average factors, fragmented loads and limited origin data. Use supplier activity data and consolidate routes.	Measure sourcing share, tCO_2e/t ingredient and freight intensity. Quantification needs supplier baselines.	Low initial internal spend. Obtain quotes for platform and verification.	Commercial / High / start within 6–18 months. Supplier and nutrition team participation.

Investment ranges in the matrix are engineering screening allowances for a single project or line. They are indicative, exclude taxes and can vary substantially with equipment size, installation

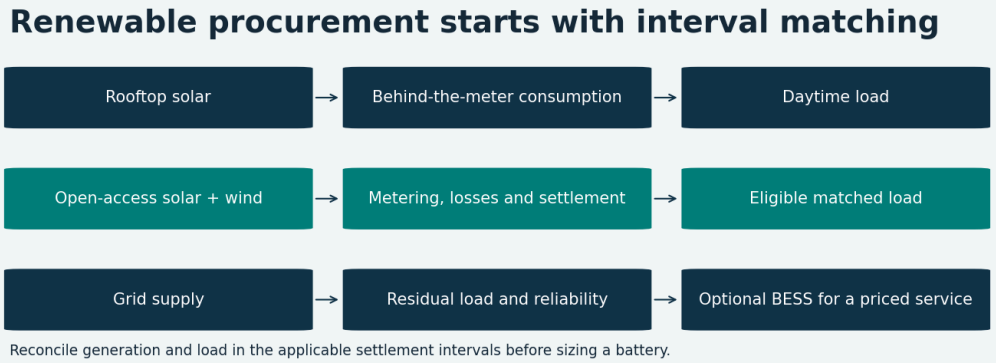
constraints, fuel, duty hours and required reliability. Validate savings by normalizing measured energy for tonnes, product mix and weather, then compare against approved specifications. The illustrative scenario packages include integration and contingency allowances.

Buy the renewable profile your plant can use

Obtain twelve months of interval consumption, tariffs and bills. Build a tariff engine for energy charges, contracted and billed demand, time-of-day charges, minimum billing and relevant duties. Obtain renewable generation profiles from each supplier and apply metering-point losses and actual settlement rules. Test daytime rooftop solar against stable midday demand. Test open-access solar, wind and hybrid against interval-resolved demand after rooftop and operating changes. Wind may improve coverage outside solar hours, while the result depends on the specific wind regime, season and connection. Compare matched energy in MWh, uncovered peak and night purchases, surplus settlement, and the landed cost of each matched unit.

For third-party open access, verify connectivity, approvals, wheeling and transmission, losses, scheduling and deviation settlement, banking and expiry, applicable surcharges, metering and changes in law. Captive or group captive procurement introduces ownership and yearly consumption obligations. The notified March 2026 amendment to Rule 3 retains the core 26% ownership and 51% annual eligible-consumption tests, with specific provisions on verification, eligible consumption and proportionality. Review the exact structure, effective provisions, consumption definitions and yearly consequences on the asset and users. The central green open-access framework uses a 100 kW baseline with a captive exception, subject to the applicable rules and implementation. [8] [9] [11]

For a state-level example, Chhattisgarh's FY 2026–27 schedule applies normal energy rates overnight and in the early morning, 80% of the normal energy rate during 09:00–17:00 and 120% during 17:00–23:00 for the covered HV categories. Normal demand charges apply across these windows. Check the exact supply category, metering provisions and intrastate access regulations before using the example. Request the applicable charges and settlement treatment against the specific project before contract award. The modeled ₹8/kWh is a marginal avoided-cost assumption for financial comparison. [10] [11]



Procure against interval-level demand and settlement rules.

For BESS, first price the residual problem. Size inverter power from the peak that can actually be shaved and usable energy from the duration it persists. A 1 MW reduction over two hours needs 2 MWh delivered. At 90% round-trip efficiency it requires about 2.22 MWh charging energy before considering design reserve, end-of-life capacity and dispatch limitations. Then test demand charge rules, avoided purchases, available charging headroom, degradation, fire protection and any applicable interconnection or regulatory conditions. Cold-chain resilience can justify a separate value stream. A reliability-led project needs the protected load, interruption duration, islanding design and backup sequencing in its specification. The financial cases below assume no battery.

A representative feed mill investment case

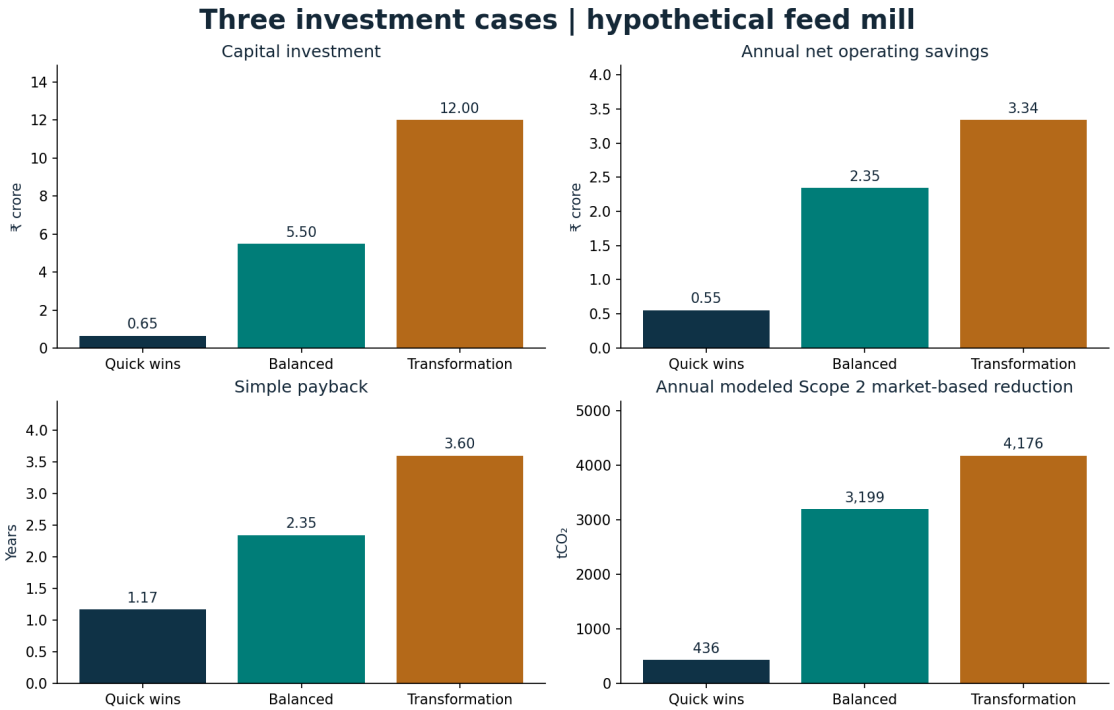
Imagine a compound-feed plant selling 300,000 tonnes a year. Two production shifts create a daytime and evening load, with limited auxiliary use overnight. The model assumes annual demand of 8 GWh and peak electrical demand of 1.8 MW, equivalent to a roughly 51% annual load factor. An illustrative annual split is 45% from 06:00–14:00, 45% from 14:00–22:00 and 10% overnight. These aggregates are descriptive. Rooftop and open-access allocations are assumed to be matched after loss and settlement and require verification against actual interval data.

The plant buys 20,000 GJ of natural gas per year at ₹700/GJ and pays ₹8/kWh of avoidable grid energy charge. Matched open-access energy costs ₹5.20/kWh landed, assumed inclusive of variable access charges for the scenario. Owned rooftop cost is represented by capex and incremental O&M. Baseline variable energy spend is ₹7.80 crore a year. Baseline modeled combustion and purchased electricity are 1,122 and 5,816 tCO_2 per year. The natural gas factor is 0.0561 tCO_2/GJ and the model fixes the CEA FY 2023–24 factor of 0.727 tCO_2/MWh to a reproducible historical benchmark. Apply the factor for the reporting period and relevant contractual instruments to a real inventory. [4] [6] [7]

Case	Gross efficiency GWh/y	Fuel saved GJ/y	Fuel switched GJ/y	Rooftop GWh/y	OA GWh/y	In O&
Quick wins	0.6	1500	0	0	0	0.0
Balanced	0.9	3500	0	1	2.5	0.1
Transformation	1.3	5000	7000	1.5	3.5	0.2

The quick-win case improves operating discipline, selects high-run-hour drives and repairs steam losses. The balanced case adds broader equipment improvements, heat recovery and matched renewable procurement. Transformation includes a heat pump on a suitable hot-water duty. The 7,000 GJ of displaced gas corresponds to 5,600 GJ of useful heat at 80% boiler efficiency. At a seasonal COP of 2.8 it adds 0.556 GWh of electricity a year. The strategic package includes integration and supplier data work, with supplier emissions excluded from modeled savings.

Case	Grid GWh	Fuel TJ	CAPEX ₹ cr	Net saving ₹ cr/y	Simple payback y	NPV ₹ cr	IRR
Quick wins	7.40	18.5	0.65	0.56	1.17	2.76	85.2
Balanced	3.60	16.5	5.50	2.35	2.35	8.91	41.3
Transformation	2.26	8.0	12.00	3.34	3.60	8.50	24.8



Illustrative financial scenarios. Scope 1 reductions are shown in the case table.

Savings equal the reduction in billed grid kWh times ₹8, less purchased open-access kWh times ₹5.20, plus avoided gas GJ times ₹700, less incremental O&M. Payback is capex divided by annual savings. NPV and IRR assume ten equal end-of-year pretax cash flows, flat prices, a 10% discount rate for NPV and zero terminal value. Levelized abatement cost divides annualized capex less net savings by modeled Scope 1 and market-based Scope 2 CO_2 reduction. A negative result is a net modeled financial saving per tonne reduced under the stated accounting assumptions. Demand savings, taxes, financing, generator backup, future replacement costs and Scope 3 reductions are excluded.

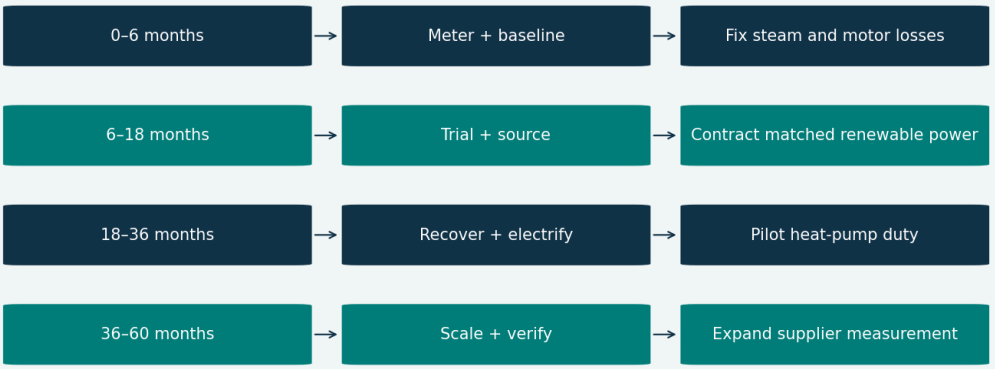
Market-based reductions assume eligible renewable attributes covering rooftop and open-access electricity, a zero operational emission factor for that portion, and 0.727 for other purchased electricity as an explicitly assumed fallback. Using the same grid factor for open-access wheeled electricity in the location-based

example, reductions are roughly 436, 1,381 and 1,632 tCO_2/year, respectively. The gap reflects accounting treatment of grid-delivered renewable power. Neither calculation provides a marginal grid displacement factor. A full inventory should add relevant non-CO_2 combustion gases, refrigerants, effluent and farm sources using reporting-period inputs.

The quick-win case offers the fastest payback. The balanced case has the highest NPV under the assumed prices and discount rate. Transformation delivers the largest annual savings and modeled carbon reductions, with a longer payback and greater sensitivity to equipment performance. A ₹1/kWh deterioration in the effective open-access spread cuts annual savings by ₹0.25 crore in the balanced case and ₹0.35 crore in transformation for unchanged matched volumes. At a lower seasonal COP of 2.2, the transformation case adds about 0.707 GWh of electricity, about 0.152 GWh above the base assumption. Finance should re-run the matched-load and tariff model with the incremental draw. At assumed annual sales of ₹600 crore, the modeled operating savings lift operating margin before depreciation by about 0.09, 0.39 and 0.56 percentage points respectively, with other costs and sales fixed.

A five-year plan for the plant and the board

Five years of implementation



Indicative implementation windows with technical and commercial milestones.

Window	Accountable functions	Investment priority and dependencies	KPIs
0–6 months	Plant head and energy manager	High. Meter lines, repair loss points, match baseline with tonnes and grade.	% energy submetered, kWh per tonne, GJ per tonne and fines rate
6–18 months	Procurement, legal, plant engineering and CFO	High. Renewable sourcing and targeted efficiency. Approvals, interval modeling and PPA review.	Matched MWh, landed cost, rejected tonnes and supplier activity data coverage
18–36 months	Engineering, quality and sustainability	Medium. Heat integration and heat-pump pilots. Verify source temperature, COP and uptime.	Useful heat recovered, seasonal COP and Scope 1 tonnes

Window	Accountable functions	Investment priority and dependencies	KPIs
36–60 months	COO, commercial and finance	Conditional. Scale validated pilots, screen storage and verify value-chain impacts.	Verified savings, inventory coverage, downtime and supplier footprint quality

Assign an executive sponsor to resolve the tradeoffs between throughput, energy, quality, recurring spend and capital. Approve a baseline first, then establish acceptable changes in pellet quality, product moisture, cold-chain service and downtime. Ask engineering to show how performance will be measured after commissioning. Ask procurement to show how fuel, power and attributes are purchased and verified. Ask finance to show sensitivity to landed tariff, energy utilization, throughput and lost production. Where matched renewable capacity is scarce, parallel commercial screening with baseline work can preserve options without committing to an unvalidated annual volume.

What will matter over the next five years

Low-cost interval monitoring and better plant controls will make it easier to compare lines and identify renewable shortfalls. Supplier traceability will become more useful as ingredient-specific product data improves. A reduction in purchased power can matter for operating cost even when upstream agriculture is the larger footprint. Treat both targets as linked business decisions, with separate owners, data and timelines.

BEE’s carbon trading compliance procedure applies to obligated entities under notified targets. Verify the exact legal entity, facility and latest notified schedules before treating an agro-processing

investment as a compliance requirement. Model any possible offset revenue only after confirming an eligible methodology and registration route. SEBI BRSR provisions depend on listing status and applicable cohorts. SEBI's 2025 FAQs describe voluntary value-chain ESG disclosures for the top 250 listed entities from FY 2025–26. Customer requests can still reach privately held suppliers through purchasing contracts. EU CBAM's definitive regime applies to specified goods by tariff code, and conventional feed, edible oil and poultry should be screened for other buyer or export requirements rather than booked as a direct CBAM cost by default. Review relevant state pollution-control consent conditions, water and effluent obligations, and process-specific permits at the plant. [2] [12] [13] [14]

TOPTIER's perspective on decarbonization and business performance

First establish how much saleable product the plant gets for each unit of energy. Compare renewable offers on matched, landed kWh and verify legal eligibility and ownership of environmental attributes. Then target the process heat duties with enough utilization and a credible heat source. Validate uptime and product quality before scaling. Assess storage against measured peak, mismatch or resilience needs and verify the planned dispatch can deliver the value claimed in the investment proposal.

For your next energy review, put three records on the table together. Bring the plant's interval power data, the last year of fuel and production records, and the list of top ingredients by volume. Use those records to identify where the business spends the most, which costs it can change in twelve months, and which emission sources require supplier cooperation. TOPTIER can help build and validate that plan for a single plant or a multi-site portfolio.

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"The most effective decarbonization strategy is not necessarily the one with the most advanced technology. It is the one that delivers the right combination of energy efficiency, commercial savings, operational reliability, and measurable carbon reduction."

References and verification

Public sources checked on 21 November 2026. Historical benchmarks retain their original period. Cost and engineering inputs in the case are assumptions.

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