TOPTIER ENERGY SERVICES PVT LTD

How India’s Snack Plants Can Cut Energy Costs and Carbon Emissions

TOPTIER Industry Decarbonization Series · Packaged snacks and namkeen · 19 November 2026

Imagine the end of a namkeen shift. The packing team has already cleared the last batch, but the fryer is still hot, the exhaust fan is still running and the boiler is warming water for a clean scheduled hours later. The plant has stopped making snacks. It is still paying to make heat.

A fuel meter can put a price on those minutes. A production log tells you whether the cost buys necessary hygiene or reflects a scheduling problem. Add the electricity load curve and the oil purchase ledger, and a different picture emerges. One plant can have three distinct decarbonization decisions: process heat on the line, electricity procurement at the meter and the ingredients and packaging coming through the gate. Which should the CFO fund first? Start with the unit of energy or material the plant can stop buying without putting product or throughput at risk.



Illustrative editorial image of an anonymous industrial savoury snack frying line. AI-generated.

From raw ingredients to finished packs

01 Intake
Screen flour and pulses. Wash and slice potatoes where relevant.

02 Forming
Mix, extrude or shape. Dewater sliced products where the route permits.

03 Cooking
Fry, bake or roast to recipe. Control oil, moisture and heat.

04 Finishing
Drain, season and cool.

05 Packing
Inspect, weigh, seal and case-pack.

06 Dispatch
Hold and ship finished packs. Use cold chain only where required.

Utilities
Fuel supplies cooking and hot water. Electricity serves drives, packing, compressed air and cooling.

Residual streams
Water and starch, oily effluent, used oil, rejects, exhaust and standby losses.

Generic process map. Select equipment and utility boundaries by product family.

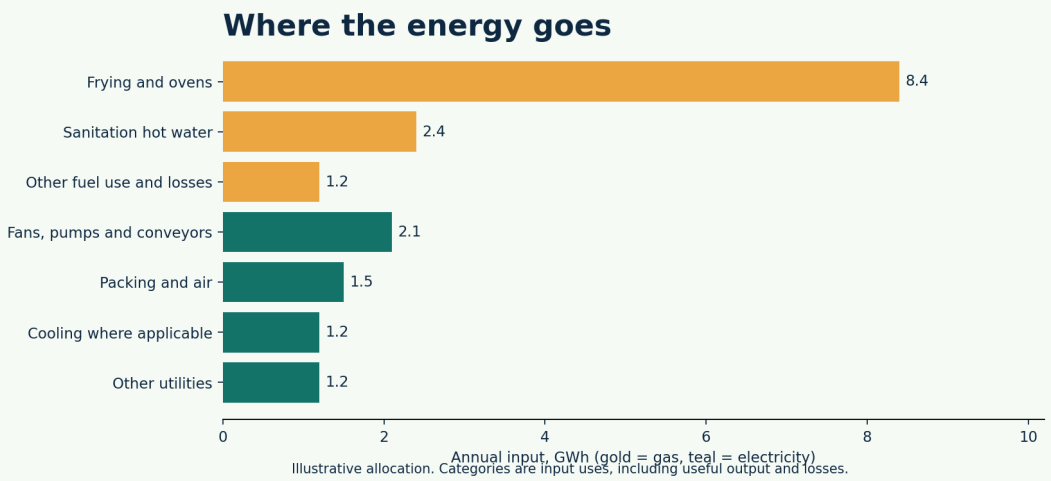
Generic namkeen manufacturing process flow, material streams and utilities.

Where a snack plant uses energy

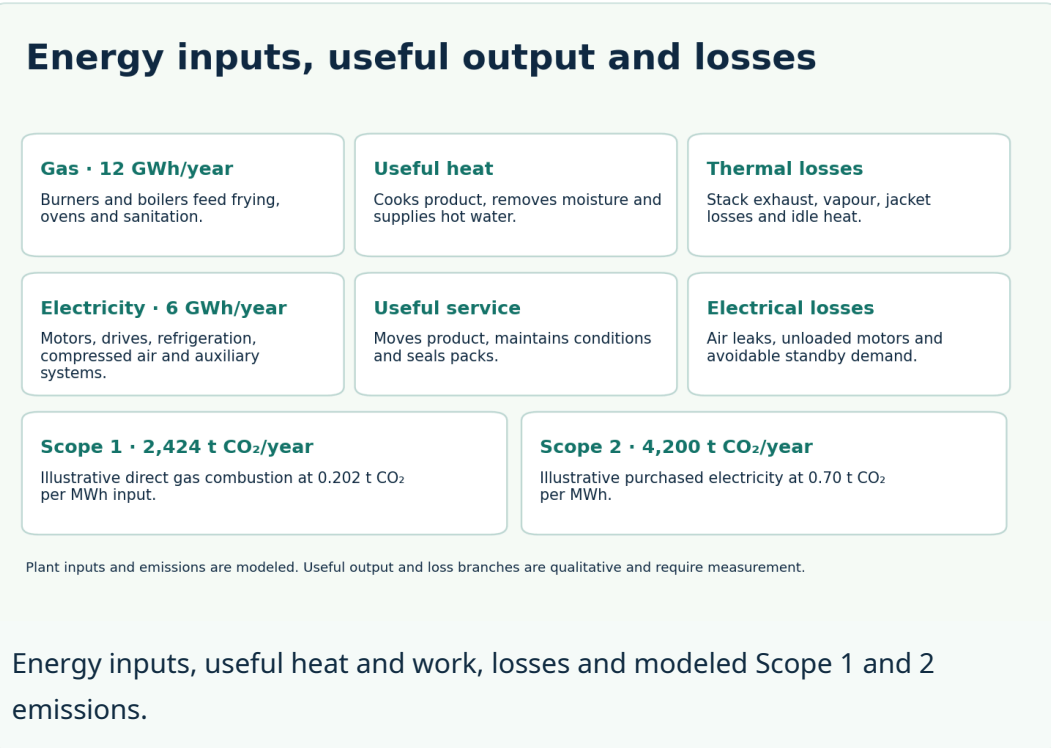
A traditional namkeen line receives and screens flour and pulses, mixes dough or prepares ingredients, forms the product, fries it, removes excess surface oil and adds seasoning. Cooling, inspection and packing follow. A potato line adds washing, peeling and slicing, often with rinsing and mechanical dewatering. A baked or roasted line trades the fryer for an oven or roaster. A mixed factory may also run sweets or chilled products. Those routes require separate baselines because concentration, dairy sanitation and refrigeration change both the thermal load and the electricity profile.

Frying transfers useful heat into the product and evaporates moisture. It also heats the oil, steelwork and circulating medium during start-up. Exhaust carries vapour and heat. The fryer can continue to lose heat during a prolonged gap between batches. Four numbers tell you more than the burner rating: kilograms of saleable product, kilograms of water removed, metered fuel input and minutes at temperature without product. Add product mix, incoming moisture, oil uptake and quality acceptance to find out whether a lower number per tonne reflects an improvement or a different recipe.

Boilers or direct-fired heaters may serve fryers and ovens depending on the installed process. Hot water for washdown and cleaning is another thermal demand, often with a different temperature and timing. Electrical loads include fans, pumps, conveyors, packing machines, air compressors and refrigeration where the product calls for it. Some plants can shift utility operation without touching the recipe. For example, check whether cleaning hot water can be stored in a hygienically designed buffer and used at the required temperature when the line is released. Measure standby losses and cleaning demand before selecting tank size.



Illustrative annual energy allocation for gas and electricity by operating activity.



Energy inputs, useful heat and work, losses and modeled Scope 1 and 2 emissions.

Measure thermal fuel on a consistent net or gross calorific basis. Match gas meters to production lots, and log electricity in settlement intervals and against production shifts. Separate electric and fuel intensity to avoid hiding fuel switching in a combined total. One international reference gives 1.0–2.1 MWh per tonne for broad potato processing, excluding starch, with scope caveats. It helps test whether units and boundaries make sense. A namkeen line

needs its own benchmark, preferably against the same SKU, moisture and packaging format on a comparable line. EU food sector BAT decision

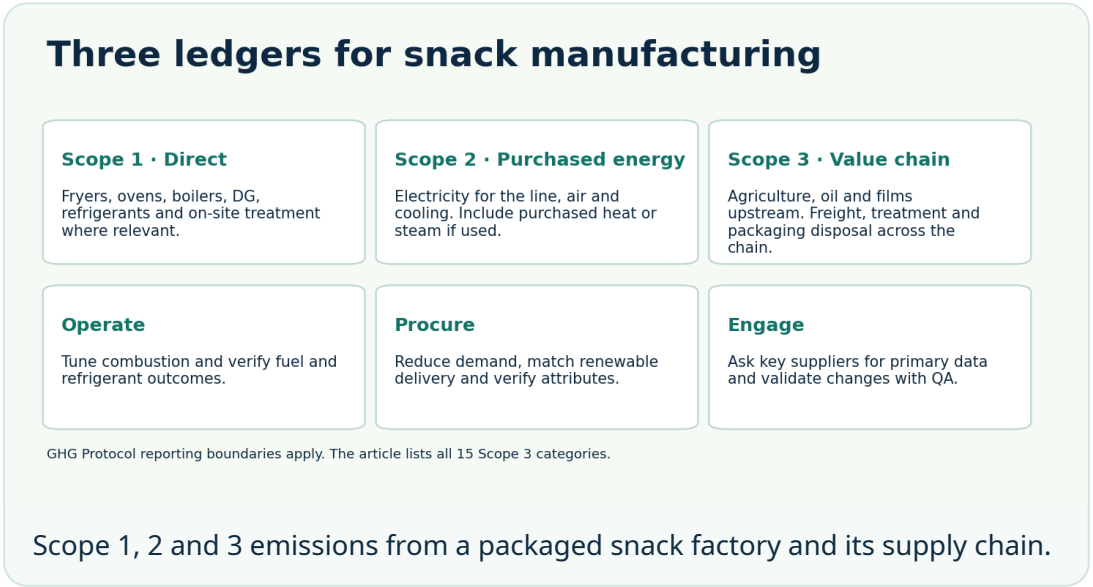
Three emissions ledgers tell different stories

Scope 1 records direct emissions within the reporting boundary. Gas or other fossil fuels burned in heaters, ovens and boilers usually matter first in a fried-snack operation. Record diesel used in backup generators and controlled vehicles separately. Track refrigerant type and makeup by system. If on-site wastewater treatment includes anaerobic conditions, assess methane and any relevant nitrous oxide using treatment design and loading data. Do not assume a generic chemical process emission from cooking. A fuel reduction is measurable through fuel bills and calibrated meters, while a reduction in refrigerant leakage needs service records, equipment inventory and an appropriate warming factor.

Scope 2 covers purchased electricity, steam, heat and cooling. Location-based accounting uses the appropriate grid-average factor for grid-delivered electricity. Market-based accounting uses qualifying contracts or certificates where applicable, with a residual mix or other allowed fallback for uncovered electricity. A PPA, a monthly bill adjustment and a renewable attribute are distinct records. Specify who owns and retires the attributes, their vintage and market boundary, and how the same megawatt-hour is prevented from supporting two claims. Report both methods where the GHG Protocol requires dual reporting. A better market-based

figure may reflect a valid purchase claim without an equivalent fall in location-based emissions. GHG Protocol standards and guidance

Scope 3 starts with the purchasing ledger. Oil and agricultural ingredients merit an early screen because cultivation, fertiliser, processing and land-use change may alter their footprints substantially. Flexible packaging and cartons also deserve attention, along with freight and food losses. A purchasing team can choose specifications and ask suppliers for origin and emissions data. It needs farmers, processors, converters and carriers to validate production changes. Start with mass and spend screening, then request primary data for the suppliers driving the result. Compare alternative films only after validating shelf life, oxygen and moisture barrier, machinability and consumer safety. Saving a few grams of plastic can be a poor trade if it adds food waste. GHG Protocol standards



Scope 1, 2 and 3 emissions from a packaged snack factory and its supply chain.

Scope 3 category	Applicability and first check
1 Purchased goods and services	Prioritize oil, flour, crops, milk if used, film and cartons. Ask suppliers for origin, footprint boundaries and allocation methods.

Scope 3 category	Applicability and first check
2 Capital goods	Inventory fryers, ovens, refrigeration, buildings and energy assets in the acquisition year.
3 Fuel- and energy-related activities	Add upstream fuel and electricity emissions and applicable grid losses outside Scopes 1 and 2.
4 Upstream transport and distribution	Include paid inbound freight, third-party storage and outbound freight purchased by the reporting company.
5 Waste generated in operations	Capture outsourced treatment for rejects, sludge, film scrap and used oil. Confirm treatment routes.
6 Business travel	Use booked distance, travel mode or spend where activity data is unavailable.
7 Employee commuting	Survey shift travel, buses and travel modes.
8 Upstream leased assets	Screen leased sites and assets omitted from Scopes 1 and 2 under the chosen boundary.
9 Downstream transport and distribution	Estimate third-party distribution and storage after sale where the reporting company does not buy the service.
10 Processing of sold products	Usually limited for ready-to-eat retail packs. Screen ingredients and bulk products sold for further processing.
11 Use of sold products	Ready-to-eat ambient lines have limited direct use emissions. Screen reheating and chilled lines using actual product requirements and guidance.
12 End-of-life of sold products	Model consumer packaging and food disposal by market and treatment route.
13 Downstream leased assets	Screen owned assets leased to others outside operational Scopes 1 and 2.

Scope 3 category	Applicability and first check
14 Franchises	Screen only where franchise relationships exist and operations sit outside the inventory boundary.
15 Investments	Screen financial investments outside operational Scopes 1 and 2.

Where to spend the first rupee

A conventional line may run at temperature between batches, vent recoverable heat and use compressed air even where a blower or electric actuator would do. That creates exposure to gas and power prices and obscures the actual cost of short runs. A transitioning plant adds submetering, operating standards, waste heat recovery and a measured renewable contract. An advanced plant uses those same measurements to evaluate process electrification, hygiene-compatible heat integration and supplier changes. These are practice profiles. Fuel price, product mix, utilisation and downtime can move the rankings, so compare rupees and carbon per saleable tonne as well as absolute impact.

Start burner tuning and insulation work with a production and maintenance walkdown. Set dependable heat-up and idle procedures by SKU, repair insulation and check steam traps and condensate return where steam is present. Check packing-air leaks while production is down and trend compressor output at normal line pressure. Treat variable-speed drives as a load-specific decision. A fan with a throttled damper and variable requirement can respond differently from a constant-duty motor at its design load.

Log electricity and output before the change and verify both again after it.

Recover heat only once you have a credible sink. A fryer stack or exhaust stream may be hot when washdown demand is low. A buffer tank can bridge some gaps. Grease, fouling, pressure drop and cleanability determine whether the retrofit survives everyday operation. Keep exhaust and process water physically separated, obtain engineering and food-safety approval and assess fire risk and access for cleaning. FSSAI sets a 25% total polar compounds limit beyond which vegetable oil cannot be used. Monitor oil quality and send used oil through a documented authorized route. A heat project cannot be allowed to compromise that discipline. IFC food processing guidelines · FSSAI RUCO guidance

An industrial heat pump typically fits lower-temperature work first: preheating cleaning water, recovering condenser heat or serving other validated hot-water loads. Compare electricity input with displaced fuel input at measured seasonal performance and actual operating conditions. Preserve a way to reach required sanitation temperatures and maintain availability during maintenance. Electric boilers can supply steam but have a larger incremental electricity requirement per unit of delivered heat than a suitable heat pump. Direct fryer electrification needs a separate controls, electrical capacity and quality trial. Biomass or biogas can fit a site with dependable supply and compliant combustion and handling. Check lifecycle emissions, air consents, ash, variability and hygiene. Give hydrogen a place on the watchlist when supply, safety, cost and technical fit become credible. IEA Renewables for Industry



Illustrative stainless snack packaging equipment and unbranded film. AI-generated.

What changes on the factory floor

Conventional	Lower-energy option
Fryer at temperature during gaps. Heat exits through the stack.	Idle controls and a cleanable heat exchanger feeding a verified hot-water sink.
Boiler serves low-temperature wash and other duties.	Separate suitable hot-water loads and pilot a heat pump. Preserve temperature assurance.
Fixed pressure and speed. Utility schedules follow equipment defaults.	Right-size compressed air and test speed controls on variable loads.

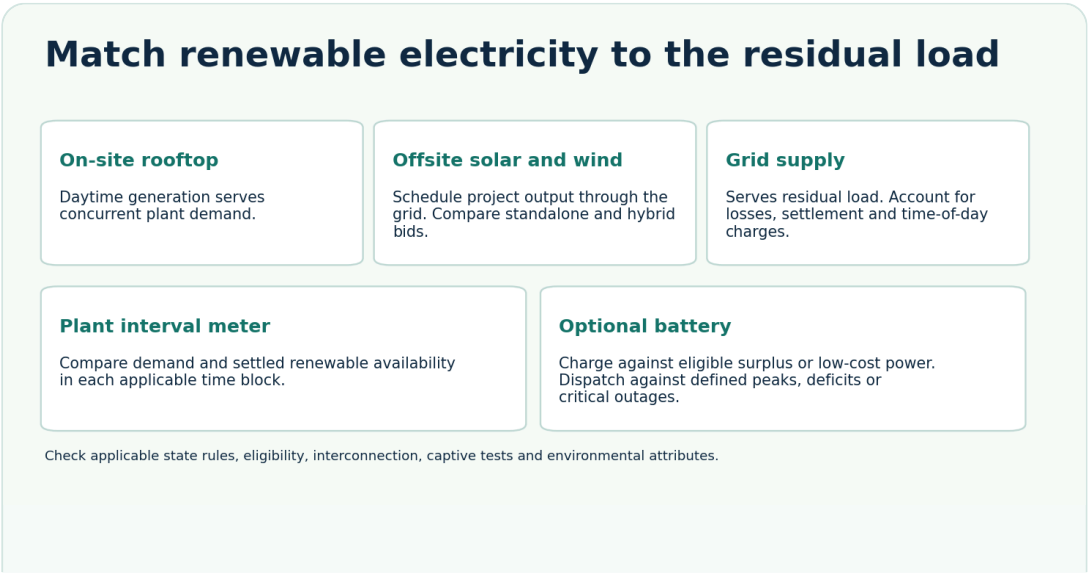
Prioritize QA, confirmed duty, installation windows and measured savings.

Conventional snack manufacturing practices and practical lower-energy alternatives.

Buy renewable electricity around the load

Rooftop solar works where daytime demand, usable roof area and interconnection line up. Separate structural capacity and roof rights from the electricity case. Open-access solar can extend daytime coverage, while wind can fill some evening or seasonal gaps depending on the specific project. Compare solar, wind and hybrid offers with a full year of interval consumption and actual project generation data. Run the contracted delivery profile through state settlement rules, plant outages, monsoon variation, weekend load and expansion plans. Quantify useful units, surplus, lapsed banking, deficit purchases and peak demand after doing this.

At 14:00 a plant might have 0.4 MW of residual load and receive 0.6 MW of contracted output. Over one hour that creates 0.2 MWh of surplus. At 20:00 the same plant might need 0.7 MW while wind supplies 0.3 MW, leaving a 0.4 MWh deficit over the hour. These numbers are illustrative. Banking or storage may bridge parts of the mismatch. At 85% round-trip efficiency the 0.2 MWh could yield only 0.17 MWh before battery power and capacity limits. Long stretches of deficit point back to the generation mix or contract structure. Short peaks, high demand charges, outage losses or a binding storage obligation may justify a battery even when energy-only arbitrage cannot.



Solar, wind, grid electricity and optional storage matched to manufacturing load.

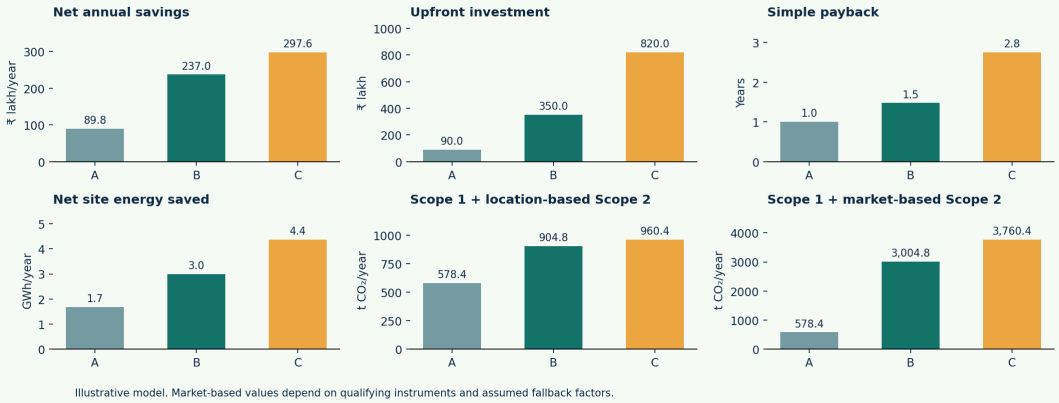
Compare third-party open access, owned captive and group captive on effective delivered cost. Include transmission, wheeling and losses, banking and settlement charges, scheduling, applicable surcharges, and the cost and risk of captive equity. Check the tariff component and time-of-day charges actually avoided, plus the contracted demand that remains payable. The central Green Energy Open Access framework generally enables eligible non-captive loads of 100 kW or more, including qualifying aggregation in one distribution division. Captive consumers have a central load-threshold exception. State implementation, approvals, banking and orders must be checked for the specific connection. Rule 3 was replaced in 2026. The principal tests are at least 26% captive-user ownership and at least 51% of annual generation consumed for captive use. Identified generating units and group structures have specific rules. For associations of persons, check the contribution of each user's admissible captive consumption and the applicable exception for users holding at least 26%. Verification failure can trigger applicable surcharges and carrying cost. Price commercial risk into the PPA and shareholders agreement. Green OA Rules · 2023 amendment summary · 2026 captive amendment · Ministry explanation

What an illustrative plant could save

Consider a hypothetical 20,000-tonne-per-year plant on a two-shift production schedule, with off-shift cleaning and base loads. It uses 6 GWh of electricity and 12 GWh of natural-gas fuel input annually.

Illustrative maximum demand is 1.25 MW, implying a 55% annual load factor. That corresponds to 300 kWh of electricity and 600 kWh of fuel per saleable tonne. The plant pays an avoidable electricity charge of ₹8.50/kWh and ₹4.50/kWh of gas input. Renewable units used and settled cost ₹5.50/kWh landed. These are model assumptions. They do not quote a utility tariff or achievable PPA rate. Demand charges, taxes and unrelated operating costs are excluded. Fixed network or contract charges must be priced separately when applicable.

Scenario A cuts idle heat, steam or hot-water losses and wasted power. Scenario B adds heat recovery and a 3 GWh delivered renewable purchase. Scenario C uses broader controls and heat integration, plus a heat pump delivering 1.5 GWh of useful heat using 0.50 GWh electricity at seasonal COP 3. It displaces 1.8 GWh of gas input at an assumed 83.3% effective conversion efficiency. That package also includes 4 GWh of settled renewable procurement and budgets for a supplier pilot. Battery sizing and full fryer electrification are follow-on decisions with no modeled financial or emissions credit.



Illustrative investment, payback, energy, operating savings and emissions across three scenarios.

Metric	Baseline	A · Efficiency	B · Efficiency + renewables	C · Heat integration
Gas input, GWh/year	12.00	10.80	9.60	7.80
Site electric load, GWh/year	6.00	5.52	5.40	5.84
Settled renewable units, GWh/year	0.00	0.00	3.00	4.00
Residual grid-billed, GWh/year	6.00	5.52	2.40	1.84
Total energy inputs saved, GWh/year	0.00	1.68	3.00	4.36
Annual energy cost + incremental O&M, ₹ lakh	1,050.0	960.2	813.0	752.4
Net annual savings, ₹ lakh	0.0	89.8	237.0	297.6
Upfront investment, ₹ lakh	0	90	350	820
Simple payback, years	—	1.00	1.48	2.76
Scope 1 reduction, t CO_2/year	0.0	242.4	484.8	848.4

Metric	Baseline	A · Efficiency	B · Efficiency + renewables	C · Heat integration
Scope 2 location-based reduction, t CO_2/year	0.0	336.0	420.0	112.0
Scope 2 market-based reduction, t CO_2/year	0.0	336.0	2,520.0	2,912.0
10-year NPV, ₹ lakh	0	462	1,106	1,009
Pre-tax project IRR, %	—	99.7	67.3	34.4
Net abatement cost on Scope 1 + location-based basis, ₹/t CO_2	—	-12,993	-19,898	-17,092

Net savings equal baseline electricity and fuel cost less post-project gas, residual billed electricity, contracted renewable units and incremental annual O&M (₹5/12/25 lakh in A/B/C). Upfront budgets are ₹90/350/820 lakh. B and C assume third-party contracts with the landed rate covering settlement costs and with no captive equity. Model NPV and project IRR use constant year-end savings for ten years, with no taxes, escalation, residual value or financing effects. Discount rate is 10%. Abatement cost is annualized capex less net annual savings, divided by Scope 1 plus location-based reductions. A negative value indicates net savings under these assumptions.

Direct CO_2 uses an assumed natural-gas factor of 0.202 t/MWh of fuel input. For comparability the example assumes 0.70 t/MWh of grid electricity in the location-based calculation and for market-

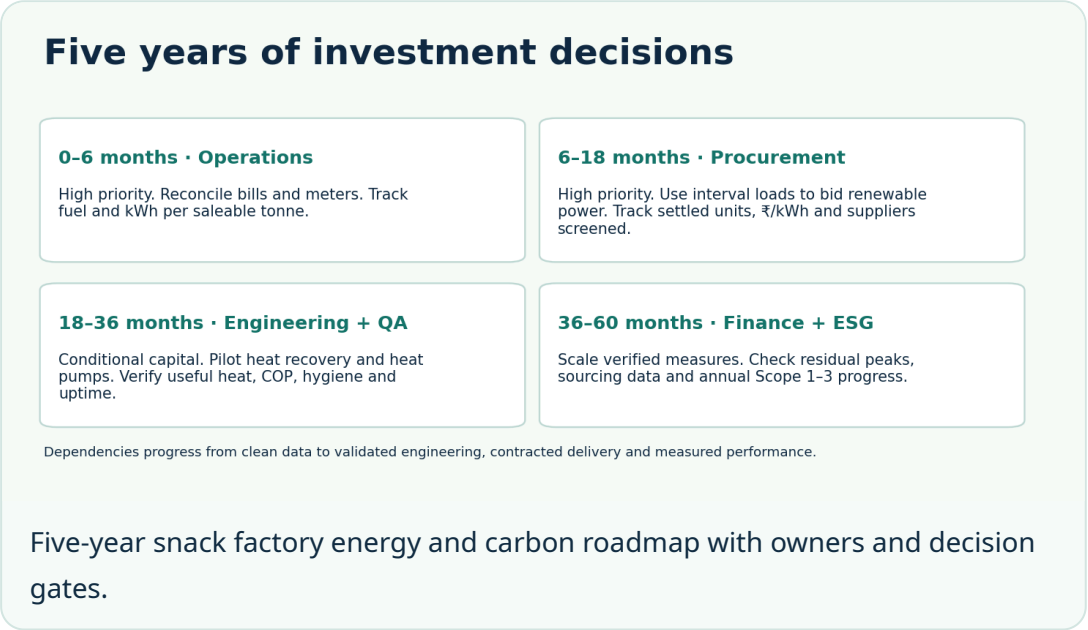
based uncovered supply as an illustrative fallback. This is a scenario assumption, not a quoted CEA factor. The market-based case assumes qualifying renewable attributes and a zero operational generation factor for covered units. No credits, upstream benefit, Scope 3 reductions or refrigerant savings are counted in the financial case. The modeled gas and electricity changes are combustion and generation CO_2 rather than a complete CO_2e inventory.

An important distinction for the investment committee is that B saves 0.60 GWh of electricity as efficiency and replaces the purchase source for another 3.0 GWh. Site electricity demand falls to 5.40 GWh. Grid-billed electricity falls to 2.40 GWh. For inventory purposes, grid-delivered power is still 5.40 GWh if the renewable contract is offsite and delivered through the grid. Under those assumptions the location-based electricity reduction is 420 tonnes of CO_2, while the illustrative market-based electricity reduction is 2,520 tonnes if attributes qualify and the modeled fallback applies. The direct gas saving is separate. Compare both results using the same boundaries each year. GHG Protocol Scope 2 · CEA grid factor database

The moderate package has the strongest balance of illustrative payback and scale in this example. At ₹7.00/kWh landed instead of ₹5.50, its annual net savings fall by ₹45 lakh to ₹192 lakh and payback rises to about 1.8 years. A falling grid tariff narrows the value of the PPA, while higher gas prices improve the relative value of thermal savings. At ₹8.50/kWh power and ₹4.50/kWh gas in this case, a heat pump at COP 3 costs ₹2.83 per delivered kWh for electricity, compared with ₹5.40 for combustion at 83.3% efficiency, before capex, demand charges, integration and maintenance. Model those costs and seasonal temperature effects before approving a retrofit. At constant revenue of ₹100 crore, the

modeled annual savings in B are equivalent to 2.37 percentage points of EBITDA margin if fully realised and before any excluded costs.

A five-year roadmap



Five-year snack factory energy and carbon roadmap with owners and decision gates.

In the first six months, give operations and finance one reconciled baseline. Set up line-level fuel and electricity measurement, tie both to saleable production and close obvious idle-load losses. Assign food safety the approval of any change involving washdown, temperature or product contact. The first decision is whether a saving persists across the product mix and through seasonal demand. For a clean comparison, record planned shutdowns, moisture changes and new lines.

During months six to eighteen, have procurement run solar, wind and hybrid bids against the logged intervals. Run engineering trials for insulation, hot-water storage and heat recovery. Ask the biggest

oil, ingredient and film suppliers for footprint and traceability data. Contracting and engineering can run in parallel, provided the electricity forecast includes the projects that actually move the load. Stage investments against delivery dates and independently verify the first season of savings.

From months eighteen to thirty-six, pilot a heat pump on a suitable water loop, collect performance across the seasons and broaden supplier initiatives. Scale over years three to five only where hygiene, availability, savings and carbon results meet agreed criteria. Make decisions on storage or deeper electrification using measured residual peaks and downtime costs after the earlier changes. Leave a fallback path for the plant to complete a batch and safely clean following a power interruption.

What changes over the next five years

Large customers can ask for credible product data before they put a price on carbon. Make scope boundaries, ingredient origins, packaging weights, plant allocation and treatment of waste auditable. EU CBAM’s definitive phase concerns listed commodity codes in covered sectors. Ordinary packaged snack exports do not enter that mechanism merely because they use energy or packaging. Give tender and customer questionnaires their own track. In India the Carbon Credit Trading Scheme compliance mechanism applies to notified obligated entities and targets. Check the current notification schedule by entity and site, and leave carbon-credit income out of a capital case unless eligibility and monetisation are evidenced. Listed buyers may also seek value-

chain data in connection with BRSR Core. SEBI's 2025 FAQ describes voluntary value-chain disclosures from FY2025–26 for the top 250 listed entities, distinct from applicable entity reporting or assessment requirements. Verify the actual filing obligation for the legal entity. EU sector list · BEE Indian carbon market · SEBI BRSR FAQ

State electricity orders, consent conditions and food rules deserve the same care. For example, a Maharashtra project should use the effective MERC tariff and green open-access orders for the licensee including the March 2026 order in Case 75 of 2025 where applicable. Obtain a site-specific landed bill simulation and track effective dates. Review the site's pollution board consents for fuel changes, discharge limits and treatment arrangements. Separate oil and high-strength streams where practical and confirm the required effluent treatment through actual wastewater sampling. Efficiency schemes can support audits in eligible clusters, with specific programme coverage to be verified. MSEDCL tariff proceedings · IFC food-processing guidance

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TOPTIER's perspective on decarbonization and business performance

The sound investment sequence is to meter the process, remove avoidable fuel and electricity demand, and contract renewable supply around the load that remains. Compare ownership and third-party structures on delivered and usable energy, including the cost of failure to qualify as captive. Then use a heat balance to evaluate recovery or electrification. Schedule storage against

residual peaks, generation surplus and an explicit reliability case. In supplier procurement, give the largest categories enough attention to measure a change at source. Each step needs an accountable owner and an agreed way to verify savings. A plant can get a good energy price and still miss the budget by contracting more power than it can use.

Start with twelve bills, one year of interval data and a week of fryer, sanitation and production logs. That is enough to ask better questions of the equipment vendor, the power developer and the operations team. The resulting investment plan should explain which costs fall this year, which risks it takes on, and what the plant manager needs to measure for the board.

TOPTIER ENERGY SERVICES PVT LTD
Strategic Renewable Energy Procurement | Industrial Energy Optimization | Decarbonization Advisory
www.t-esco.in · +91 9156337278

> “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.”