How India’s Tyre Factories Can Cut Energy Costs and Carbon Emissions

TOPTIER ENERGY SERVICES PVT LTD · Industry Decarbonization Series · 20 November 2026



AI-generated editorial illustration of a generic curing hall.

The hidden energy story

An idle tyre press can still draw heat. A running mixer can raise the plant’s demand peak in minutes. And the largest carbon opportunity may sit in a purchase order for rubber or carbon black. The three problems show up in different places, so no single electricity bill or carbon dashboard will reveal all of them.

A tyre factory turns natural and synthetic rubber, carbon black or silica, process oils, steel reinforcement, textiles and curing additives into products for passenger vehicles, trucks, two-wheelers and other applications. The recipe and construction vary by product. Production begins with weighing

and staging the materials. An internal mixer compounds them in batches, mills or downstream equipment finish the mix, and batch-off equipment cools the compound. Extruders form treads and sidewalls. Calenders coat textile or steel reinforcement. Bead-making equipment prepares the rings that anchor the tyre to the rim. Building machines bring these parts together into an uncured, or green, tyre. A press then applies controlled heat and pressure to vulcanize it. Inspection may include uniformity checks or X-ray inspection where the product calls for it. [1]



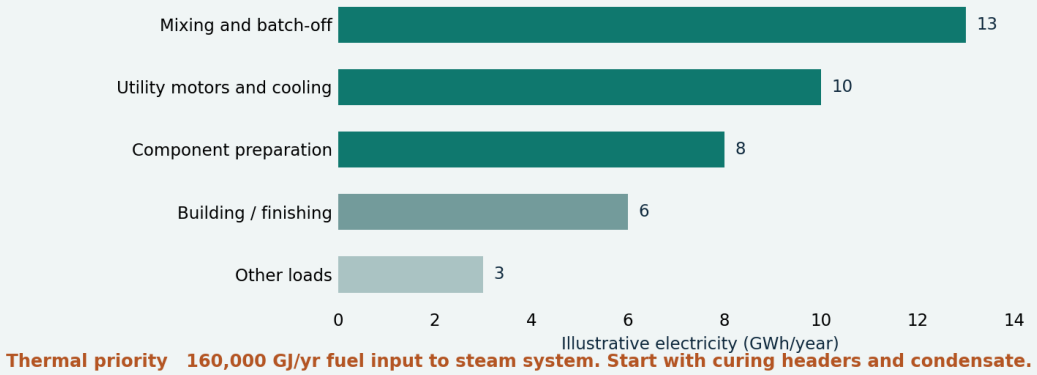
The main production stages and their utility connections.



AI-generated editorial illustration of a generic finished-tyre inspection area.

Track electricity and thermal energy independently. A mixer’s electricity demand changes with compound, batch weight, rotor speed and discharge temperature. Look at kWh per kilogram of acceptable compound and the time at which mixing peaks coincide with other heavy loads. On the steam side, compare fuel per tonne of saleable product, steam per press cycle and condensate return by shift. A heavier truck tyre, a longer curing recipe or a change in scrap rate can alter the comparison even when the boiler is performing exactly as before. Use product-family baselines and log stoppages, maintenance and changeovers alongside the meter data. Published ISO 50001 tyre case studies illustrate how manufacturers normalize performance using process power, steam and relevant production variables. [1]

Where to meter first



Thermal priority **160,000 GJ/yr fuel input to steam system. Start with curing headers and condensate.**

Source: hypothetical facility. Electrical allocation only. Thermal fuel is tracked separately.

The hypothetical plant uses 40 GWh of electricity and 160,000 GJ of gas annually.

Trace energy to useful work and losses

Electricity → drives

Mixers, extruders and auxiliaries
Useful: work, cooling and pressure
Losses: idle motors, air leaks
Carbon: purchased energy Scope 2

Fuel → steam

Boiler, header and curing presses
Useful: controlled vulcanisation
Losses: flue, leaks, blowdown and vents
Carbon: on-site combustion Scope 1

Recover and verify

Return clean condensate and heat
Lower avoidable utility demand
Measure savings per saleable tonne
Exclude upstream Scope 3 from this map

Qualitative engineering map. No measured loss shares are implied. Scope 2 basis matters for purchased power.

A qualitative energy-flow map for prioritising walkdowns and submetering.

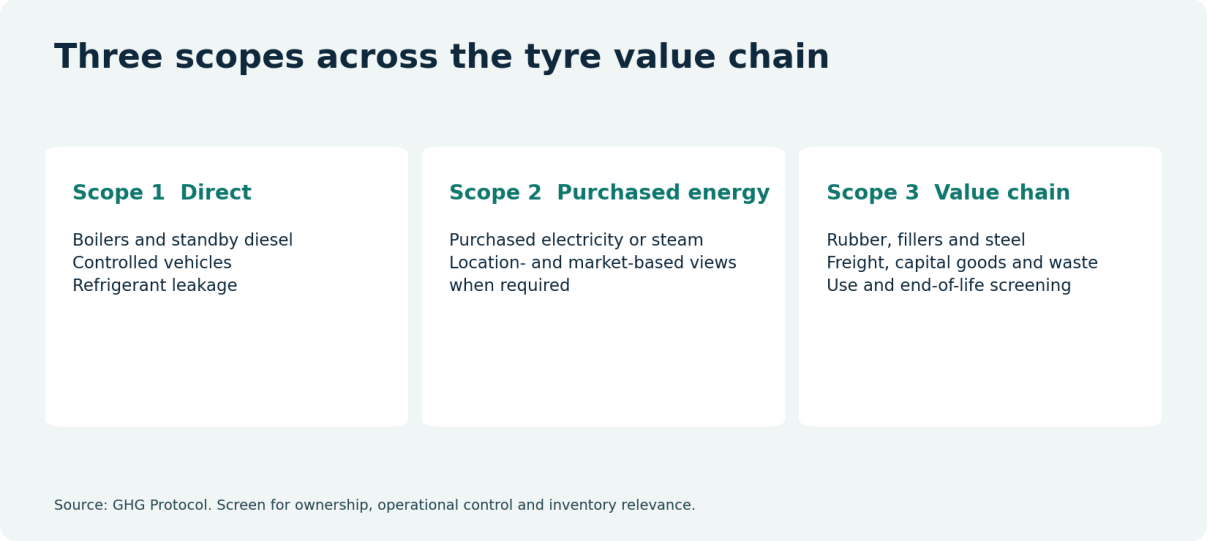
Where the carbon footprint comes from

Scope 1 includes fuel burned in boilers, thermal systems, generators and controlled vehicles. Refrigerant losses from equipment under operational control also belong here. Check for material process GHGs and for methane or nitrous oxide from on-site wastewater treatment where the treatment process warrants it. Mixing and curing may create dust or

volatile organic compounds. Manage these through the site's air pollution controls and consent conditions, and identify greenhouse gases separately using a source-specific inventory. Track boiler blowdown, cooling water, wash water, and compound and cured-tyre scrap. Treatment, storage and disposal requirements depend on site permits, waste classification and the recovery route. [2, 9]

Scope 2 covers purchased electricity, steam, heat and cooling. The location-based method uses the emissions factor for the grid serving consumption. The market-based method reflects qualifying supplier or contractual factors and the required factor hierarchy for unmatched load. Report both where the GHG Protocol requires dual reporting. A PPA price settles the commercial question. The contract's environmental attributes, their exclusive ownership and retirement or equivalent evidence settle the reporting question. Avoid claims on electricity whose attributes are sold elsewhere. Annual contractual coverage, interval-level physical matching and avoided system emissions each answer a different question. [2, 3]

Scope 3 begins with natural rubber, synthetic rubber, carbon black, steel cord, textiles and packaging, then extends to equipment, upstream fuels, freight, waste, tyre use and end-of-life. Start Category 1 with a mass-based material inventory and supplier-specific cradle-to-gate factors where comparable. Ask suppliers to identify allocations, recycled-content boundaries and the year of the data. A spend-based baseline can expose coverage gaps, then give way to better product-level data. Procurement can steer specifications and supplier selection. Changes to filler, recycled steel or rubber formulation also need engineering approval for fatigue, grip, wear and curing performance. [2]



The three emissions scopes and examples of each.

For category screening, test **1** purchased inputs, **2** capital goods, **3** upstream fuel and energy, **4** purchased freight and warehousing, **5** third-party waste treatment, **6** business travel, **7** employee commuting, **8** upstream leased assets outside Scopes 1–2, **9** downstream transport outside purchased freight, **10** third-party processing of intermediate sold products where applicable, **11** use of sold products, **12** end-of-life, **13** downstream leased assets, **14** franchises and **15** investments. Assign applicability and significance after checking the reporting boundary and commercial arrangements. [2]

For tyre use, explain the choice of including or reporting separately indirect use-phase emissions associated with rolling resistance. A product LCA needs comparable assumptions for vehicle type, distance, load, tyre pressure, surface, energy mix and service life. Attributing the whole vehicle’s fuel use to the tyre would overwhelm the analysis. Work with OEMs and fleets to compare performance over equivalent service and check for trade-offs in wear and safety. At end-of-life, distinguish retreading where suitable, material recovery, and authorised processing. Record physical flows, EPR evidence and inventory allocation explicitly. A certificate and a measured change in the company’s carbon inventory serve different purposes. [2, 8]

Why conventional operations leave money on the table

A successful steam system keeps the presses inside their curing window. That same reliability can hide waste. Headers stay pressurized during downtime, traps fail open, flash steam vents because no nearby end use was designed for it, and hot condensate goes to drain. Before changing supply technology, walk the system on a production shift and again during a shutdown. Match trap surveys with operating hours. Measure return temperature and contamination risk before increasing condensate recovery. Set boiler sequencing by useful steam demand and verify performance at partial load.

Electric utilities have the same problem. Raising compressed-air pressure makes the worst-served machine work, while every leaking connection consumes more. Log pressure at the compressor and at the end user. Repair leaks, review inappropriate air uses and tune the lead–lag sequence before investing in a new compressor. Test whether cooling water flow and chiller setpoints can follow actual process requirements. When a brief power disturbance scraps batches, evaluate controls ride-through and targeted backup before sizing backup for the entire plant.

Operating profile	Energy cost and carbon	Technology and business exposure
Conventional	Mixed fuel and grid exposure, limited visibility into cost per saleable tonne	Reactive utilities maintenance and limited supplier emissions evidence
Transitioning	Lower measured utility intensity and some renewable supply, subject to site tariffs and operating hours	Submeters, ISO 50001 practices, condensate recovery and initial supplier-data collection
Advanced	Lower fossil-heat exposure where electrification is viable, better managed landed electricity cost and product carbon	Dispatch and interval controls, qualified low-carbon materials and auditable power attributes. Greater integration and commissioning demands

These profiles describe operating models. Plant-to-plant comparisons should disclose the product mix, capacity utilisation, energy boundary and baseline year. An older radial line and a newer mixed-product plant can report very different specific energy figures without a like-for-like efficiency gap. For a CFO, a fuel price shock or a missed OEM disclosure deadline is a risk even when the factory has a comfortable average energy cost. Delaying metering and supplier engagement leaves fewer options when a boiler needs replacement or a customer changes its procurement requirements.

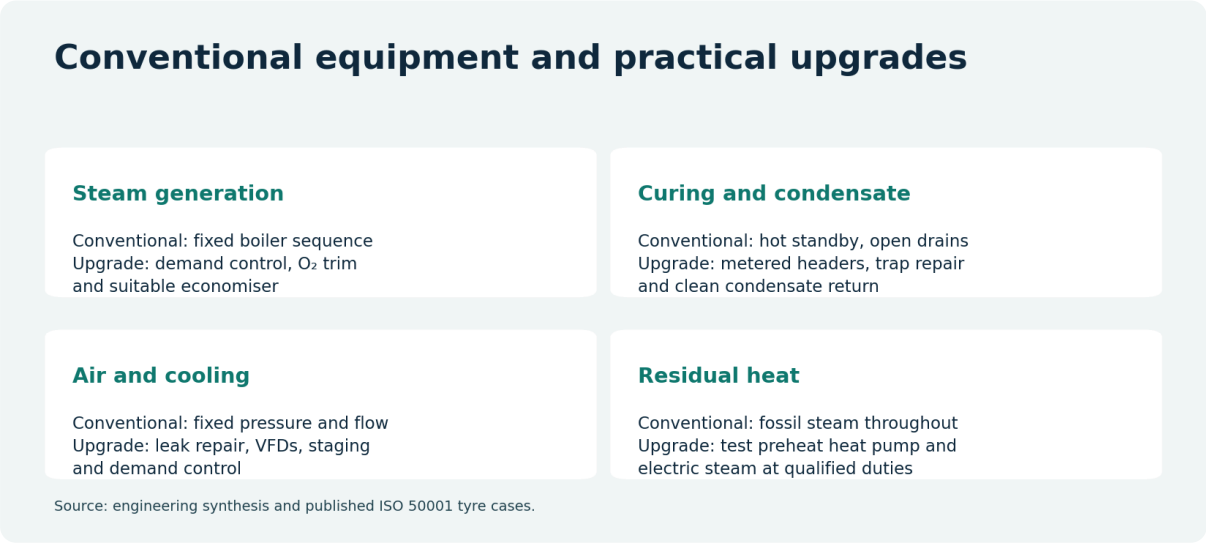
Technology alternatives for a working plant

Begin with conventional equipment whose performance can be checked against a meter. Repair traps and insulation, optimise excess air within the burner’s safe operating range and recover clean condensate. An economiser or flash recovery system can deliver savings where the heat has a steady sink and the engineering accounts for water treatment, corrosion limits and backpressure. Track the amount of steam the presses

actually use after the work. Otherwise, the gas savings may be hard to distinguish from a slower production month.

High-temperature heat pumps can be screened for duties with a stable source and modest temperature lift, such as preheating water using recoverable low-grade heat. Ask suppliers for a guaranteed coefficient of performance at the seasonal source temperature and actual supply temperature. Compare footprint, cooling integration, refrigerant management and maintenance support. For high-pressure steam, evaluate electric boilers where power capacity and cost support them, retaining redundancy during the transition. Pilot electric or alternative curing on a qualified line. Release it to production only after confirming cure uniformity, cycle time, scrap and performance of the finished tyre.

Biomass or biogas merits a lifecycle and continuity check in regions with reliable local supply. Assess delivered usable energy, moisture, storage, ash handling and air-pollution control. Account for biogenic CO_2 separately where applicable and assess combustion non-CO_2 gases and upstream impacts. For hydrogen, compare infrastructure, delivered heat cost, supply reliability and lifecycle emissions with the options already available to the plant. There is rarely a reason to pay a premium for a new fuel before quantifying the steam the factory could stop wasting.



Technology options depend on measured loads, utility conditions and quality constraints.

Renewable power procurement for the plant’s actual load

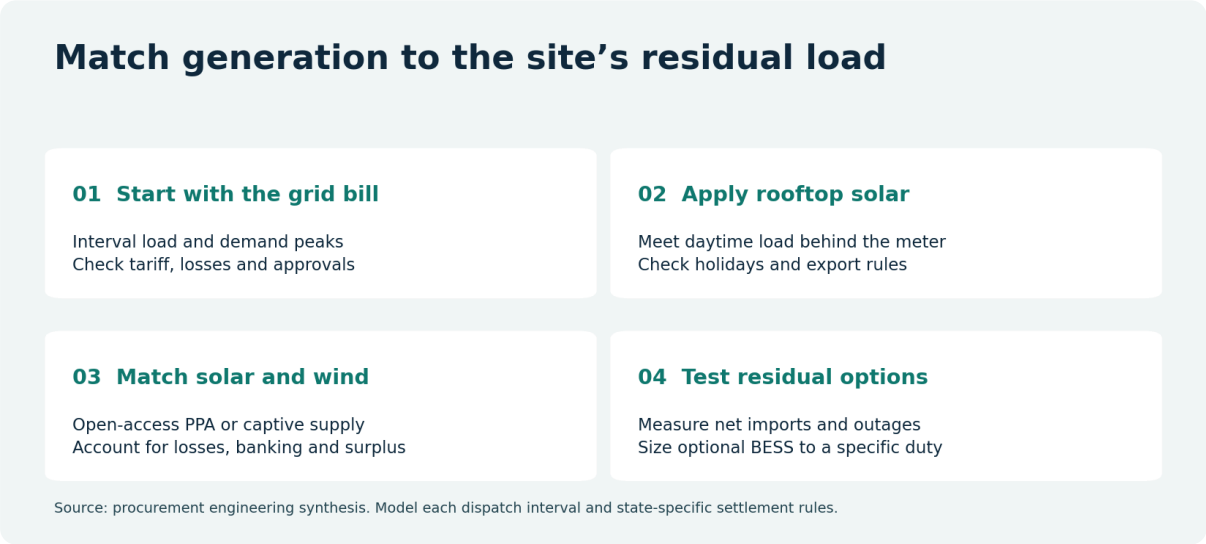
Rooftop solar is a starting point where the roof and daytime base load support it. Obtain 12 months of bills and interval readings, preferably at the settlement interval, and check transformer limits, protection and export treatment. Model how much rooftop output will be consumed behind the meter on weekends and holidays before estimating the energy left for an open-access PPA.

Test solar and wind profiles individually, then combine them for the same annual volume. Wind may cover evening and night demand or seasonal shortfalls, depending on the resource region and month. Compare matched energy and residual purchases by settlement block. The relevant ₹/kWh is the cost per usable unit at the consumer meter after losses, wheeling, transmission, applicable surcharges, scheduling costs, banking and unutilised energy. Keep demand charges, fixed charges and time-of-day pricing visible as separate rows. Include seasonal demand, maintenance outages and contract minimum-offtake provisions. A low headline PPA tariff can lose its advantage when surplus units cannot be used or banked.

Compare third-party green open access, captive ownership and group captive. Third-party procurement can avoid an equity commitment, subject to applicable charges and contractual terms. Captive ownership adds asset and operating exposure. Group captive adds equity, shared compliance and counterparty risk. India’s green open-access framework generally uses a 100 kW sanctioned load or contract demand threshold with specified aggregation provisions, while captive consumers are exempt from the load threshold under the central rules. Verify state implementation and the applicable network approvals. Amended national Rule 3 retains at least 26% captive-user ownership and at least 51% captive consumption across the financial year, subject to the identified-unit and association-of-persons

provisions, the applicable proportionality cap and exemptions. Review verification procedure and surcharge exposure before signing. [4, 5]

Maharashtra illustrates why a state check matters. MERC's current open-access index and draft directory distinguish the notified regulations from its draft 2026 distribution open-access text. Base the bid comparison on the applicable notified provisions, tariff order and utility settlement. MSEDCL lists the MYT order issued on 25 March 2026 in Case 75 of 2025. For an HT plant, pull the relevant year's demand, energy and time-of-day terms from the applicable schedule, then reconcile them to the bill. Stress-test any proposal separately, including possible changes to banking and storage. Confirm how the actual site's bill and scheduling statements reconcile banked energy and charges. [6, 12]



Assess rooftop, open-access and storage options against the same settlement-interval load.

Once the solar–wind mix is optimised, size storage against the remaining problem. Peak shaving calls for dependable discharge during the billed maximum-demand interval. Tariff arbitrage calls for a sufficient spread after round-trip losses and cycling costs. Reliability calls for a critical-load analysis, islanding capability and uptime obligations. For example, delivering 4 MWh at 85% AC round-trip efficiency requires about 4.71 MWh of charging energy. At ₹5.20/kWh to charge, the energy component alone

is about ₹6.12 per delivered kWh before equipment and degradation. Apply contracted dispatch constraints and check for overlap between savings streams. A battery reserved for an outage may have less capacity available for daily peak shaving.

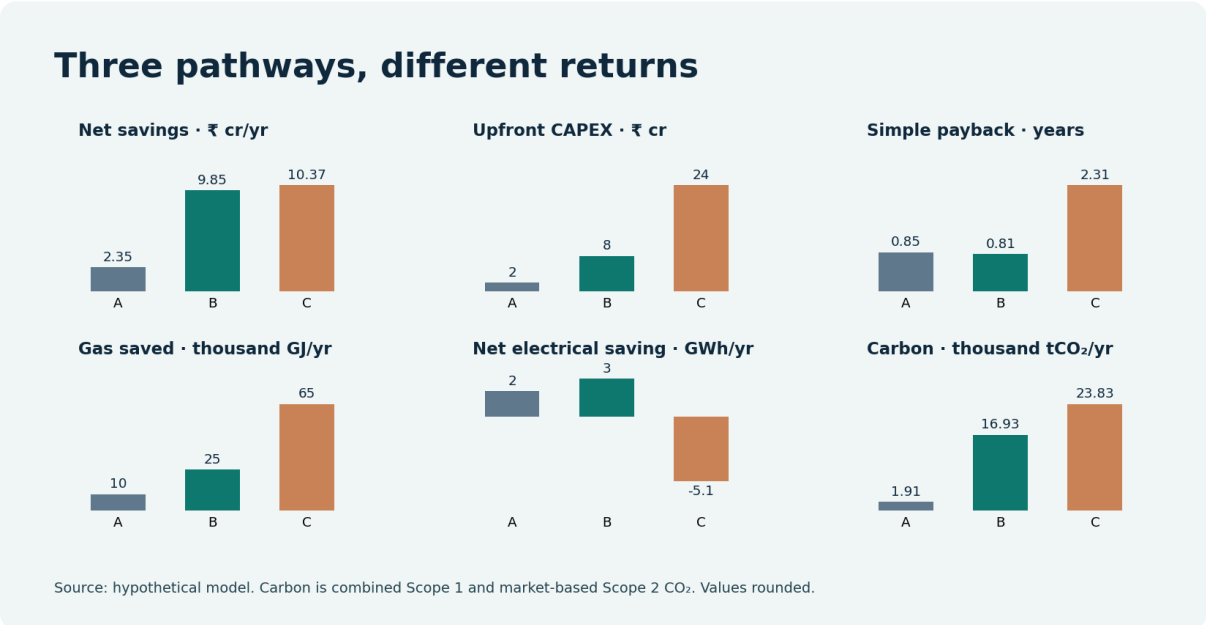
A hypothetical Indian tyre plant

The model assumes 50,000 tonnes of saleable tyres per year, 40 GWh of purchased electricity and 160,000 GJ of natural gas on a net-calorific basis. That is 6.08 GJ of combined purchased electricity and fuel per tonne. At 8 MW maximum demand, average electrical load is 4.57 MW across the calendar year, or about 57% load factor. Shift schedules, curing baseload and outages would shape the actual interval profile. No interval simulation is implied by the renewable volumes below. The project starts with no qualifying renewable attributes and uses the stated illustrative factors for both baseline Scope 2 views.

The avoided grid energy rate is ₹8.00/kWh, usable renewable energy is priced at ₹5.20/kWh landed and gas costs ₹900/GJ. These are assumptions for screening, not a utility tariff or market quote. Demand charges are held constant. Baseline annual modelled spend is ₹46.40 crore. Use an illustrative grid CO_2 factor of 0.675 t/MWh, and natural gas combustion CO_2 of 0.0561 t/GJ. The model omits non-CO_2 gases, residual-mix changes, equipment embodied emissions and upstream fuel emissions. Scope 3 projects remain unquantified. [2, 3, 10]

Annual inputs and outputs	Baseline	A · Efficiency	B · Efficiency, heat recovery and renewables	C · Deeper transformation
Electricity demand, GWh	40.0	38.0	37.0	45.1
Matched renewable procurement, GWh	0	0	20	35
Remaining conventional billed energy, GWh	40.0	38.0	17.0	10.1
Natural gas consumption, GJ	160,000	150,000	135,000	95,000
Incremental maintenance and programme OPEX, ₹ crore	0	0.15	0.40	1.20
Annual modelled spend, ₹ crore	46.40	44.05	36.55	36.03
Net annual savings, ₹ crore	—	2.35	9.85	10.37
Upfront investment, ₹ crore	—	2	8	24
Simple payback, years	—	0.85	0.81	2.31
10-year NPV at 10%, ₹ crore	—	12.44	52.52	39.72
Indicative unlevered IRR	—	117.5%	123.1%	41.9%

Annual inputs and outputs	Baseline	A · Efficiency	B · Efficiency, heat recovery and renewables	C · Deeper transformation
Scope 1 CO_2 reduction, t/yr	—	561	1,403	3,647
Scope 2 market-based CO_2 reduction, t/yr	—	1,350	15,525	20,183
Scope 2 location-based CO_2 reduction, t/yr	—	1,350	2,025	−3,443
Levelised cost per reduced tonne, market-based basis, ₹/t	—	−10,594	−5,050	−2,713



Results compare modelled pathways for the same hypothetical plant.

What moves the investment decision

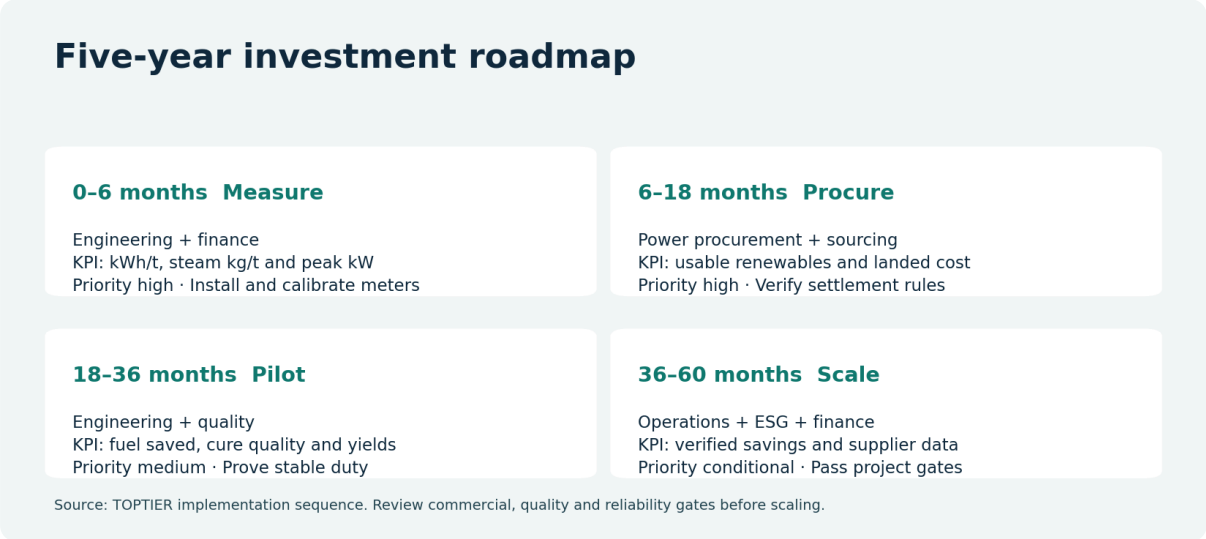
B avoids 3 GWh of demand, saves 25,000 GJ of gas and purchases 20 GWh of matched renewable energy. Savings are ₹2.40 crore electricity efficiency, ₹2.25 crore gas efficiency and ₹5.60 crore from the landed power spread, less ₹0.40 crore running costs. C avoids 4 GWh through efficiency and 25,000 GJ through thermal efficiency, then replaces a further 40,000 GJ of gas. At 80% gas-to-useful-heat efficiency and 98% electrical conversion efficiency, replacement takes approximately 9.1 GWh. No battery benefit is booked. The 35 GWh in C assumes more renewable supply can be matched after the plant adds electrical heat. Both assumptions need a site test.

The model applies a zero generation factor to matched renewables only in the market-based result and presumes eligible attributes are retained. All electricity is treated as grid-delivered for the location-based view. In C, location-based Scope 1 plus Scope 2 falls by just 204 t of CO_2 per year, versus about 23,829 t on the modelled market-based basis. The grid intensity at which the electric boiler alone matches displaced gas combustion is about 0.247 tCO_2/MWh. At ₹900/GJ, avoided gas alone supports about ₹3.95 per incremental kWh before additional equipment and demand costs. Assess the heat investment separately from the value of the extra renewable volume.

Cash flows are constant, pre-tax and unlevered for ten years, with all investment at time zero and no terminal value. IRRs are high because the model assumes immediate annual savings relative to upfront investment and mostly contracted renewable supply. It excludes captive equity, deposits, escalation, replacements and working capital. Levelised abatement cost is annualised CAPEX less net operating savings, divided by the combined Scope 1 and market-based Scope 2 reduction. Negative figures indicate net modelled savings under that accounting basis. At assumed sales of ₹500 crore, annual savings represent potential operating margin gains before depreciation of 0.47, 1.97 and 2.07 percentage points respectively, holding every other cost constant.

Every ₹1/kWh increase in usable renewable cost reduces net savings by ₹2 crore in B and ₹3.50 crore in C. At ₹6.20/kWh, the respective savings fall to ₹7.85 crore and ₹6.87 crore. If only 80% of contracted renewable energy is matched and the plant still pays for the full contracted volume with zero surplus recovery, annual savings fall by ₹3.20 crore in B and ₹5.60 crore in C at the assumed grid rate. Incremental C versus B adds ₹16 crore of CAPEX for ₹0.52 crore a year under the base assumptions. A is attractive where procurement is constrained. B has the strongest modelled NPV. C needs a stronger heat, carbon or reliability case before investment.

Five years from metering to verified performance



Move from metering and procurement to piloting and verified implementation.

In the first six months, plant engineering and finance should agree the baseline and normalise it for product mix, scrap, operating hours and ambient conditions where material. Assign each large user a meter and an owner. Launch leak detection, trap repairs and demand-peak investigation. At 6–18 months, the power procurement team should test rooftop, solar, wind and hybrid offers on the revised load. Finance should reconcile actual settlement to the award model. Procurement should set a supplier-data coverage target for the highest-emitting purchased materials.

At 18–36 months, plant engineering and quality should test heat recovery and electrification with defined steam quality, cure and product acceptance criteria. Model a fuel-price downside and a grid reliability downside. At 36–60 months, scale projects that pass commercial, quality and reliability gates. Use annual measurement and verification to refresh forecasts. Track material footprint per tonne, energy per saleable tonne, residual peak imports, eligible renewable attributes and rejected production so gains can be traced back to operational decisions.

The next competitive advantage

Tyre manufacturers increasingly need auditable data for customer procurement, product carbon assessments and regulatory reporting. India's CCTS compliance mechanism applies to notified obligated entities. Check the current facility list by legal entity and site, including any upstream integrated operations, before assigning a direct obligation. Use the same facility-level approach for BEE's Perform, Achieve and Trade scheme where a designated-consumer notification applies. [13] In India, listed manufacturers should confirm BRSR applicability and the relevant BRSR Core assessment or assurance phase. Value-chain disclosure provisions have a separate schedule and voluntary treatment under SEBI's 2025 relaxation. Keep facility consents, boiler and emission monitoring, effluent records and waste-tyre EPR responsibilities aligned with actual operations. [7, 8, 9]

For exports, check customs codes against EU CBAM Annex I. Finished pneumatic tyres under heading 4011 fall outside the current direct CBAM list. Natural-rubber traceability under the EU Deforestation Regulation may be more immediate for covered tyre exports, depending on applicable product and operator status. The European Commission lists 30 December 2026 for large and medium operators and 30 June 2027 for most micro and small operators. Confirm product and operator coverage and collect plot-level traceability and supplier evidence as applicable. Product-footprint

requests from OEMs can also arrive through tenders and supplier codes ahead of regulatory deadlines. [11]

TOPTIER's perspective on improving business performance through decarbonization

Fund energy improvements in the order in which they make the next decision easier. Measure the heat that reaches saleable product, because recovering heat changes the size of the boiler replacement. Remove avoidable electrical load before procuring power, because the residual demand determines the solar–wind mix. Stress-test the PPA against real settlement and validate the residual peaks before paying for storage. Ask procurement and R&D to work on material emissions in parallel, since a boiler project will have little bearing on the footprint of purchased rubber and reinforcement.

The next board review can begin with three questions. How much steam do we purchase or generate for every tonne we sell? How much renewable energy would actually be credited to our load in our state? Which three raw materials carry the most embedded emissions, and do we have data from their suppliers? Bring 12 months of bills, interval data, fuel records, production by family and the largest material categories to the discussion. Those inputs make it possible to turn an energy target into a shortlist of investable projects.

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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

Sources reviewed 20 November 2026. Benchmark years and illustrative assumptions are identified in context.

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