TOPTIER ENERGY SERVICES PVT LTD

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

A practical guide to extrusion and utility efficiency, renewable open access, and the carbon footprint of copper, aluminium and polymers.



Guarded electrical cable extrusion line with a cooling trough and take-up reel in a fictional Indian factory

By TOPTIER ENERGY SERVICES PVT LTD

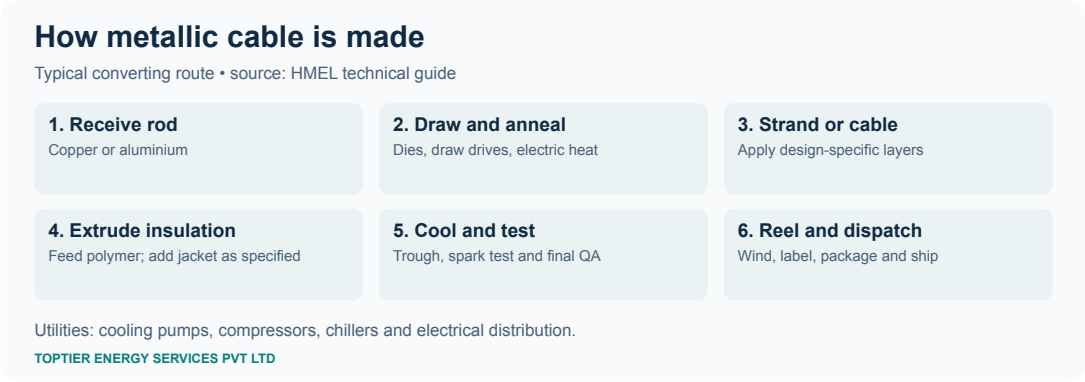
A cable can pass its final electrical test and still carry the cost of a poor production run. Every rejected metre has already used conductor metal, polymer, drive power, heat and cooling. The electricity bill shows a single total. It cannot tell the CFO which part

bought saleable cable and which part paid for keeping a line warm through a product change.

That distinction matters before the plant signs a renewable power purchase agreement. If a shutdown protocol, better cooling controls and fewer start-up rejects cut the daytime draw, the factory may need a smaller solar allocation. If drawing and extrusion run overnight, a wind allocation may be more valuable than another block of daytime generation. A procurement decision that starts at the production line gives finance a better demand forecast and engineering a better reason to trust the savings estimate.

Where a cable plant uses energy

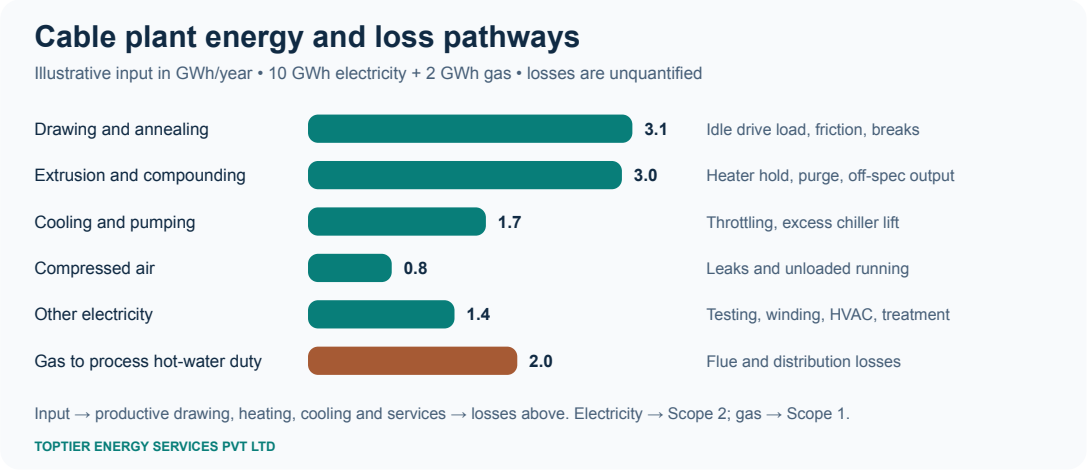
A metallic cable begins as copper or aluminium rod. Drawing machines pull it through dies to reach the specified diameter. Copper may then pass through an annealer to restore ductility lost in drawing. Stranding equipment assembles conductors where the design requires it. Extruders apply insulation and, where specified, a protective jacket. Cooling, spark testing, winding and final tests precede dispatch. Shielding, armouring, specialised curing and multiple extrusion passes depend on the product family. HMEL technical guide



Cable manufacturing stages from rod receipt to testing and dispatch

These stages have different energy signatures. Drawing and stranding depend on drives and line tension. An in-line resistance annealer consumes electricity to heat the conductor. Extruders combine motor load with barrel and die heating. A chiller reacts to cooling demand, but the pumps serving it may run at close to full speed even when several lines stop. The same mismatch occurs when compressors maintain pressure for a line that uses air only intermittently. Hours in hold mode, frequency of grade changes and utilisation explain more about some high bills than installed motor capacity does.

An integrated plant with metal melting and rod casting has a different profile. Furnace duty, holding losses and metallurgy can make heat or furnace electricity a major issue. A facility that buys rod avoids that energy inside its own gate and still carries the upstream rod footprint in purchased goods. Optical-fibre drawing, colouring, buffering, cabling and jacket extrusion need a separate baseline where present. Silica preform fabrication and high-temperature fibre drawing are distinct operations. Keep their energy and product denominators out of a metal conductor conversion comparison.



Illustrative electricity and fuel flow through cable plant equipment and loss pathways

Start with a two-week metering campaign across a representative mix of alloys, gauges and insulation grades. Record 15-minute feeder load, line state, good output, rejects and changeovers. Use kWh per saleable tonne where mass supports a fair comparison, and kWh per kilometre within a defined cable family. Convert these data into a monthly energy balance against the utility meter. Use a longer baseline for seasonal cooling and purchasing decisions. A rising kWh per tonne can mean a production-mix shift towards finer wires, which often require additional passes. Analyse product mix before treating the change as an equipment fault.

Where the carbon footprint comes from



Factory direct emissions, purchased energy and upstream and downstream cable emissions

Scope 1 covers direct emissions. Candidates include fuel used in on-site furnaces or heaters, diesel generators, controlled vehicles, refrigerant leakage, and any material process gases or greenhouse gases from on-site effluent treatment. Account for fuel by type and net calorific value. Test refrigeration leaks against refrigerant purchase and service records. For converting plants, routine electric extrusion and resistance annealing contribute through purchased electricity. On-site combustion and process gas use require their own inventory. IPCC stationary combustion guidance · GHG Protocol standards

Scope 2 covers purchased electricity, steam, heat and cooling. The location-based result for grid electricity uses the geographic grid average. Where the market-based method applies, report it alongside the location-based result. Use eligible supplier or contractual factors and document the applicable residual mix or fallback for unmatched use. A power contract needs an explicit allocation of energy attributes, with evidence of tracking and cancellation or retirement where applicable. Procured MWh, utility settlement MWh and MWh supported by attributes are three quantities worth reconciling monthly. GHG Protocol Scope 2 Guidance

Scope 3 spans suppliers, distribution and the customer. Start with purchased metals, compounds and drums. Specify conductor grade and independently documented cradle-to-gate factors. Ask rod suppliers to show the production route, recycled-content evidence and energy attributes behind a quoted factor. Request the equivalent boundary and method from each supplier. A lower factor per tonne of delivered material has little value if purity, drawability or break frequency destroys saleable output.

For power cables, electrical losses over service life can be substantial under particular duty cycles. Joule losses increase with the square of current and with resistance. Compare conductor options on delivered function, including load factor, resistance at working temperature, route length, life, grid mix, allowable temperature rise and installation cost. Larger cross-sections can reduce use-stage losses while increasing upstream material impacts. Treat operating losses as a product lifecycle calculation. For corporate Scope 3, document whether such losses are included as indirect use-phase emissions under Category 11, the applicable boundary and any overlap with customer reporting. Passive fibre does not carry load current like a metallic power cable. Nexans

cable product environmental profiles · GHG Protocol Scope 3 calculation guidance

Scope 3 category	Cable-plant screening and control
1. Purchased goods and services	High priority. Bill of materials by supplier and grade. Procurement can specify data and qualify alternative metals and compounds with suppliers.
2. Capital goods	Quantify new lines, furnaces, equipment and buildings in acquisition years. Engineering and vendors provide asset quantities.
3. Fuel- and energy-related activities	Include upstream fuel and electricity and relevant transmission and distribution losses. Reconcile to Scope 1 and 2 activity data.
4. Upstream transportation and distribution	Include inbound freight and purchased logistics, including paid outbound where applicable. Collect mode, distance and load with carriers.
5. Waste generated in operations	Track off-site treatment of polymer scrap, metal, used oil and sludge. Use verified routes and keep avoided recycling claims separate.
6. Business travel	Use booking and mileage data. Screen magnitude annually.
7. Employee commuting	Estimate distance and mode by site and shift. Test buses and pooled routes where material.

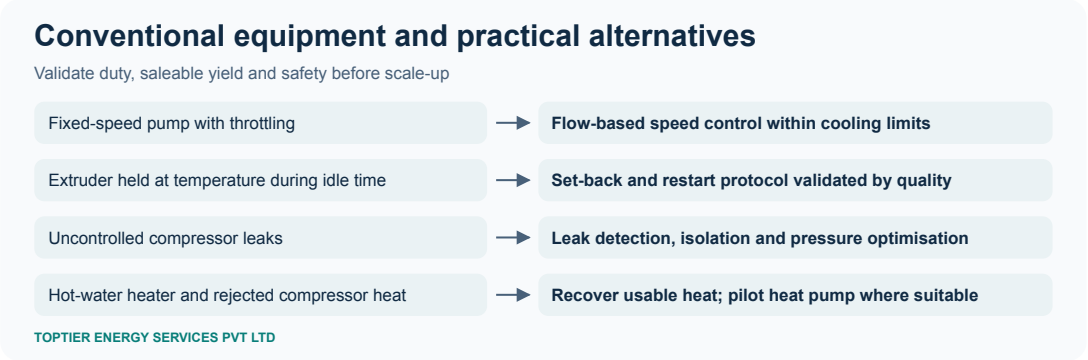
Scope 3 category	Cable-plant screening and control
8. Upstream leased assets	Assess leased equipment or premises outside Scope 1 and 2 under the chosen consolidation approach.
9. Downstream transportation and distribution	Estimate downstream transport and storage outside the reporting company’s purchased logistics boundary. Collaborate with distributors.
10. Processing of sold products	Screen further converting or assembly of sold bare rod, wire or other intermediate goods. Seek customer production data where material.
11. Use of sold products	Screen direct and indirect use-phase boundaries by product. For relevant power cables, document current, resistance, life and scenario uncertainty.
12. End-of-life treatment	Model metals recovery, polymer and drum treatment, and disposal using region-specific scenarios with recyclers.
13. Downstream leased assets	Screen assets leased to others and outside Scope 1 and 2, including rented equipment where applicable.
14. Franchises	Screen actual franchise contracts. Classify ordinary distribution by the relevant activity.

Scope 3 category	Cable-plant screening and control
15. Investments	Screen investments and joint ventures outside the organisational inventory boundary under the applicable method.

Where conventional operations lose money

A low-cost intervention begins with the Saturday night problem. Visit the plant when output drops. Check whether compressors unload against leaks, circulation pumps maintain pressure against throttled valves, or extrusion controls hold heat through a long stoppage. Compare that demand trace with the next production shift. Assign a named owner to each avoidable load and test a shutdown sequence against restart time, scrap and product quality. Make guards, interlocks and OEM temperature limits part of the operating procedure.

A line upgrade merits more scrutiny. Variable-speed drives can reduce pumping energy when duty varies, but a drawing line already running efficient variable-speed control may yield more from die condition, lubrication or fewer wire breaks. Efficient motors are easier to justify at planned replacement when loading and annual run hours are known. Insulation on safe, suitable surfaces can reduce heater losses. Maintain access, avoid overheating and check the effect on resin residence time and start-up quality.



Conventional cable plant equipment paired with tested efficiency alternatives

Cooling offers a good example of the engineering trade-off. Measure supply and return temperatures, flow and chiller kW. Raise a water setpoint only after proving downstream dimensional stability, insulation and surface finish. A warmer secondary loop may accept heat rejection through a dry cooler or tower when ambient conditions permit. Recovering heat from compressors or cooling loops makes sense when there is a nearby, coincident sink such as wash water or low-temperature preheating. Size it against heat actually used over the year. A large exchanger with a small summer heat sink soon becomes an expensive pipe fitting.

For a gas-fired hot-water duty, a heat pump is worth piloting once supply temperature, source temperature and seasonal coefficient of performance are known. Resistance heating can fit precise, high-temperature or small intermittent duties, but its electricity cost and emissions depend on the power source and duty. A melting furnace needs a separate feasibility study covering metallurgical quality, transformer capacity, power quality, electrode or refractory life and production downtime. Biomass or biogas warrants screening only for a compatible, sustained thermal load with verifiable fuel supply and local air-quality controls. Hydrogen is a low priority for typical cable conversion given the large share of direct electric equipment and the competing economics of simpler upgrades.

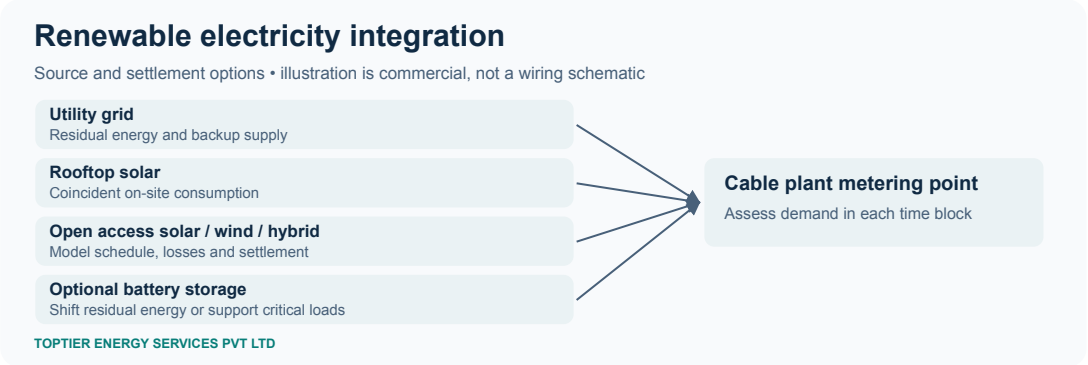
Operating profile	Likely cost, carbon and risk implications
Conventional	Grid-led supply, older auxiliaries and aggregate metering. Higher exposure to avoidable kWh and tariff changes. Supplier footprints are difficult to compare.
Transitioning	Submetering, controls, rooftop or open access renewable supply and selective heat recovery. Better cost visibility, with emerging contract and attribute-management duties.
Advanced	Family-level energy and yield tracking, interval-matched power, verified supplier data and proven electrification. Potentially lower exposure to fuel and tender risks, with more demanding engineering and data governance.

These are illustrative operating profiles. A factory can be advanced in line controls and still be early in Scope 3. Keep the comparison tied to verified kWh, rejects, safety, energy cost and product quality.

Buy renewable electricity against the load that remains

Rooftop solar is usually the simplest first model to test where roof structure, daytime demand and connectivity support it. Compare owned and service-provider structures using usable daytime

generation, cleaning and maintenance, roof access, outage treatment and attribute ownership. Off-site solar can supply greater volumes. Wind can cover different hours or seasons, but actual production depends on the project and geography. Simulate solar-only, wind-only and hybrid bids with interval profiles from the offered assets. A hybrid contract earns its place when it improves utilisation, cost or availability under the actual settlement rules.



Rooftop solar, utility power, offsite renewables and optional storage supplying a cable plant

Ask bidders to reconcile injected, delivered, banked, lost, lapsed and billed energy. The landed cost per useful unit can include wheeling and transmission charges and losses, banking, scheduling, deviation settlement, surcharges where applicable, standby, duties and contractual shortfall risk. A like-for-like comparison uses the avoidable grid charge in the same time band and shows fixed and demand charges separately. Read the actual electricity bill and settlement statements before assigning a demand-charge benefit. Contract demand floors can leave the billing demand unchanged even when a battery reduces a physical peak.

In a third-party open access deal, the buyer typically contracts power without captive ownership. In captive or group captive supply, ownership and consumption tests become operating obligations. The final March 2026 amendment to Rule 3 provides for

at least 26% qualifying ownership by captive users and at least 51% captive consumption of qualifying generation in the financial year. The association-of-persons provisions cap admissible individual consumption at the user's proportionate consumption, with an exception for a user holding at least 26% ownership. The rule also sets out arrangements for identified generating units, verification and surcharge consequences. Model member-level compliance in addition to group totals. Put reporting, load changes, ownership transfers and potential surcharge and carrying-cost exposures into the transaction documents. Electricity (Amendment) Rules, 2026

Under central green open access rules, the general eligibility threshold is 100 kW of contracted demand or sanctioned load, including specified aggregation within the same distribution division. Captive consumers are exempt from that load threshold. Check state metering, connectivity, capacity and scheduling requirements. The central ToD framework ties its time-band adjustment to the energy charge, so use the current state order for billed hours and rates. Ministry of Power green open access rules · ToD framework

Maharashtra example, checked 20 November 2026. Use MSEDCL's listed 25 March 2026 tariff order in Case 75 of 2025 and subsequent applicable directions for the actual voltage, tariff classification, time bands and bill components. The notified 2023 distribution open access amendment sets an 8% in-kind banking charge on energy banked and provides for unused banked surplus to lapse at the end of the applicable cycle. Confirm current cycle, time-band adjustment and route with the utility. The state's approved March 2026 RE and energy storage policy describes developer-side storage for specified new solar, wind and hybrid open-access projects above 100 kW, subject to its dates and conditions. Section 7.2 states an initial minimum of 50% of

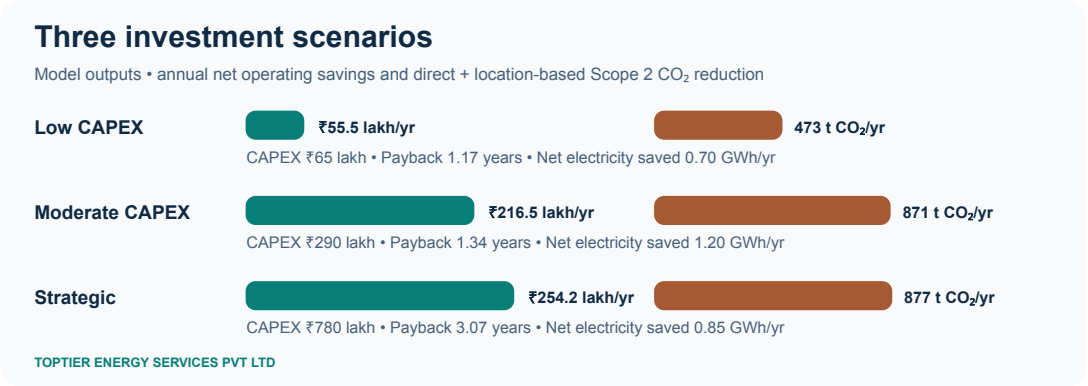
renewable capacity for two hours, starting 1 April 2026 or another date notified by the state. Check the policy, implementation circulars and approval terms for the bidder's project, including transition treatment. MERC separately lists its 2026 BESS and distribution open access proposals as drafts. MSEDCL tariff orders · Notified MERC rules · State RE and storage policy · MERC drafts

Check storage against the remaining hours of mismatch. Suppose 1.00 MWh enters a battery with 85% AC round-trip efficiency. It supplies 0.85 MWh later. At ₹5.60/kWh charging cost and ₹10.00/kWh avoidable discharge-time energy cost, gross value is ₹2,900 per such cycle before degradation, operating costs and capital. At 250 such cycles it is ₹7.25 lakh a year. A weaker price spread or low utilisation can remove that case. Add demand and outage benefits only where measured, contracted or demonstrable, and test whether the same reserved capacity can serve both duties. For reliability, specify the critical bus and islanding and protection design. Many grid-connected rooftop and battery systems require additional controls to serve an outage.

What the economics can look like

Consider a hypothetical multi-shift metallic cable plant with 10 GWh/year purchased electricity, 2 GWh/year gas input on a net calorific basis, 2 MW measured peak and a 57% calendar-year load factor. A sample production day averages 1.35 MW in an eight-hour daytime window, 1.25 MW in the following eight hours and 0.82 MW overnight. This profile only illustrates a pattern. Size real procurement using 12 months of interval consumption and generation, including partial shutdowns, weekends and seasons.

The model uses ₹8.50 per avoidable grid kWh, ₹5.60 per consumed renewable kWh landed after applicable contract and network effects, and ₹3.50 per fuel kWh. The ₹9.20 crore baseline covers variable electricity and gas only. The peak and fixed charges are held constant. Incremental annual operating costs are counted in each scenario. Investment amounts are budgeting assumptions, with route-dependent captive equity and financing excluded. Replace them with vendor quotes, outage estimates and the cost of any equity subscription before sanctioning. CEA electricity CO_2 factors · IPCC fuel factors



Net annual savings and carbon reductions across three illustrative cable plant scenarios

Metric	Low CAPEX	Moderate CAPEX	Strategic
Gross electricity efficiency, GWh	0.70	1.20	1.50
Electricity for replacement heat, GWh	0.00	0.00	0.50
BESS losses, GWh	0.00	0.00	0.15

Metric	Low CAPEX	Moderate CAPEX	Strategic
Usable off-site renewable energy, GWh	0.00	4.00	5.50
Gas avoided, GWh	0.00	0.30	1.50
Incremental O&M, ₹ lakh/year	4.00	12.00	30.00
Upfront buyer CAPEX, ₹ lakh	65.00	290.00	780.00
Net electricity demand reduction, GWh	0.70	1.20	0.85
Remaining electricity demand, GWh	9.30	8.80	9.15
Residual utility purchases, GWh	9.30	4.80	3.65
Remaining gas input, GWh	2.00	1.70	0.50
Variable operating cost incl. incremental O&M, ₹ lakh/year	864.50	703.50	665.75
Net savings, ₹ lakh/year	55.50	216.50	254.25

Metric	Low CAPEX	Moderate CAPEX	Strategic
Simple payback, years	1.17	1.34	3.07
Scope 1 direct CO_2 reduction, t/year	0.00	60.59	302.94
Scope 2 location-based CO_2 reduction, t/year	472.50	810.00	573.75
Scope 2 market-based CO_2 reduction, t/year	472.50	3,510.00	4,286.25
10-year NPV at 10%, ₹ lakh	276.02	1,040.30	782.26
10-year unlevered pre-tax IRR	85.20%	74.37%	30.28%
Levelised abatement cost, ₹/t CO_2 (Scope 1 + location-based 2)	-9,507	-19,447	-14,522
Operating margin increase, percentage points	0.22%	0.87%	1.02%

At ₹250 crore illustrative revenue and constant sales, the margin line represents pre-depreciation operating improvement. The NPV and IRR apply ten level pre-tax, unlevered annual cash flows with no terminal value, escalation or discrete battery replacement. Strategic O&M includes a screening allowance for storage upkeep. Rebuild the cash flows for actual warranties, replacements, taxes and financing. Abatement cost equals annualised upfront cost less annual net savings, divided by the annual direct plus location-based CO_2 reduction. A negative value indicates a cost saving over the model period. The low-CAPEX package needs the least capital. The moderate plan creates the highest NPV under these inputs, while the strategic plan saves the most annually and needs a larger capital commitment.

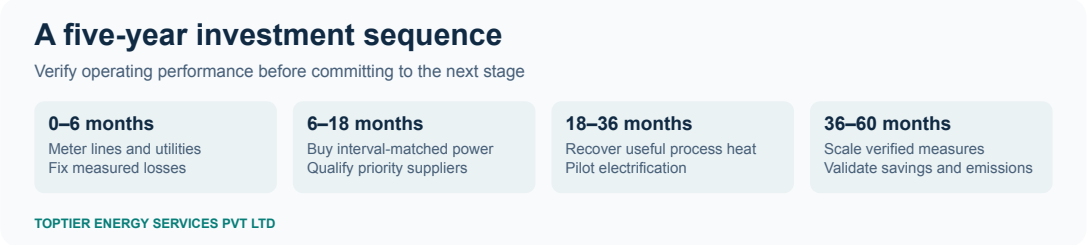
The low-capex plan repairs leaks, improves standby control and tunes pumps and production scheduling. The moderate plan adds targeted line and utility upgrades, 4 GWh of usable hybrid supply and 0.30 GWh of gas savings through heat recovery. The strategic plan assumes 1.50 GWh behind-the-meter gross electrical efficiency, 0.50 GWh electricity for heat replacement and 0.15 GWh storage losses. Gas falls by 1.50 GWh. At 80% displaced heater efficiency, the removed fuel supplied 1.20 GWh of useful heat. Here that is met by assumed heat recovery of 0.20 GWh thermal and 1.00 GWh from a heat pump with COP 2.0. The strategic storage case and renewable allocation are assumptions for comparison. They require a dispatch simulation before investment.

The model attributes changes in location-based Scope 2 to electricity demand, including the extra electricity for heat and losses and treating off-site generation delivered through the grid under the grid-average method. Its market-based column assumes qualifying attributes for consumed renewable power and applies the same grid proxy to unmatched load as an explicit modelling

simplification. Actual reporting requires the applicable factor hierarchy. National generation-average and fuel factors are used for CO_2 estimates. Fugitive emissions, methane, nitrous oxide and Scope 3 changes are outside the quantified example. The model makes no claim about avoided marginal power-sector emissions.

Test the bid against price and utilisation. In the moderate plan, a ₹1/kWh increase in renewable landed cost lowers net savings by ₹40 lakh a year. If only 3 GWh can be used and the buyer pays solely for consumed supply, savings fall ₹29 lakh versus the base model at the original spread. If it pays for the full 4 GWh with no surplus recovery, falling from 4 to 3 GWh of utilisation instead costs ₹85 lakh a year at the assumed grid price. The treatment of unused generation can alter the investment decision more than a small change in the advertised PPA rate.

A five-year implementation plan



Five-year roadmap from energy baselining to verification and scale-up

Window	Owner and funded priority	KPI and release condition
0–6 months	Plant engineering and finance. Prioritise meters, leak repairs and standby protocols.	Establish family-level kWh and scrap baselines. Confirm savings against shifts

Window	Owner and funded priority	KPI and release condition
		and comparable output.
6–18 months	Procurement, energy management and legal. Bid rooftop and open access options and implement selected controls.	Track usable renewable MWh, annualised landed price, quality and supplier data coverage. Approve after bill back-test and regulatory review.
18–36 months	Process engineering, quality and EHS. Pilot waste heat recovery and electrify suitable heat duties.	Verify annual useful heat, seasonal COP, good-output yield and fuel displacement before scaling.
36–60 months	COO, finance and sustainability. Scale verified upgrades, supplier initiatives and storage where justified.	Verify operating cash savings, Scope 1 and both Scope 2 results, and material supplier footprints. Reassess at annual procurement and budget cycles.

What customers and regulators will ask next

Industrial customers and infrastructure buyers can already ask for product disclosure, recycled-content evidence and life-cycle performance in tenders. A defensible declaration specifies cable

function, installation assumptions, lifetime and electricity factors. Purchasing teams can improve comparability by requiring suppliers to give the same system boundary and verification method. The risk of delay is partly commercial: when a tender timeline is short, recreating a metal supply chain from purchase orders at the last minute is slow and expensive.

In India, the Carbon Credit Trading Scheme compliance mechanism applies to notified obligated entities under applicable greenhouse gas intensity target schedules. Check named installations and amendments, including upstream material suppliers where relevant. BEE designated-consumer obligations are a separate screening exercise. SEBI's BRSR applies to the top 1,000 listed entities by market capitalisation, with a separate phased BRSR Core assessment or assurance framework. The March 2025 circular makes value-chain ESG disclosures voluntary for the top 250 from FY 2025–26 and associated assessment or assurance voluntary from FY 2026–27. Confirm the current listing thresholds and reporting year for the legal entity. BEE carbon market · SEBI BRSR Core framework · SEBI March 2025 circular

For EU exports, match the precise Combined Nomenclature code against CBAM Annex I. The definitive regime covers selected goods in six initial sectors. A metallic input from a covered sector does not on its own place insulated cable under CBAM. Check the product code, separately sold goods and rules in force at shipment. For domestic plants, the relevant SPCB consent and site conditions govern emissions, wastewater and waste handling. Audit drawing lubricants, scrap segregation, coolant discharge, air controls and disposal or reuse records. ZLD should be driven by consent requirements and site water balance. European Commission CBAM

TOPTIER’s Perspective: Decarbonization Should Improve Business Performance, Not Just Sustainability Reports

Start with three management decisions. First, buy fewer units by eliminating measured waste and protecting saleable yield. Second, buy the remaining units with a portfolio that matches the load and keeps landed-cost, captive and attribute risks visible. Third, buy metals and compounds with evidence of their footprint and process performance. Electrified heat and storage then compete for capital against this stronger baseline.

The CFO should be able to see how a proposal changes the utility bill, operating cash flow and exposure to a change in tariff or output. The plant head should be able to trace the same proposal to a meter, a production line and a quality limit. The sustainability team should be able to trace an emissions claim to the inventory or product footprint without counting it twice. Bring one year of electricity bills, interval data and product-family output to the first review. Those records are enough to frame the first decisions and identify the process measurements that merit investment.

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.

References

Sources checked 20 November 2026. Prices, equipment allowances and scenarios are TOPTIER illustrative assumptions.

- HMEL technical guide to wire and cable extrusion
- GHG Protocol standards and guidance
- GHG Protocol Scope 2 Guidance, 2015
- GHG Protocol Scope 3 Calculation Guidance
- Nexans cable Product Environmental Profile methodology
- Electricity (Amendment) Rules, 2026, G.S.R. 186(E), 13 March 2026
- MSEDCL tariff register, Case 75 of 2025 order dated 25 March 2026
- MERC Distribution Open Access Second Amendment, 2023
- Maharashtra Renewable Energy and Energy Storage Policy 2025–26 to 2035–36, March 2026, §7.2
- MERC draft regulations register, 2026 BESS and distribution open access proposals
- CEA CO_2 Baseline Database, v22.0, FY 2025–26
- IPCC 2006 National GHG Inventory Guidelines, volume 2, stationary combustion
- BEE Indian Carbon Market and notified greenhouse gas intensity target rules
- SEBI 2023 BRSR Core framework and phased applicability
- SEBI circular on BRSR Core assessment or assurance and value-chain ESG disclosure, 28 March 2025
- European Commission CBAM definitive regime, 2026

- Ministry of Power Green Energy Open Access amendment, 2023
- Electricity (Rights of Consumers) Amendment Rules, 2023, ToD provisions