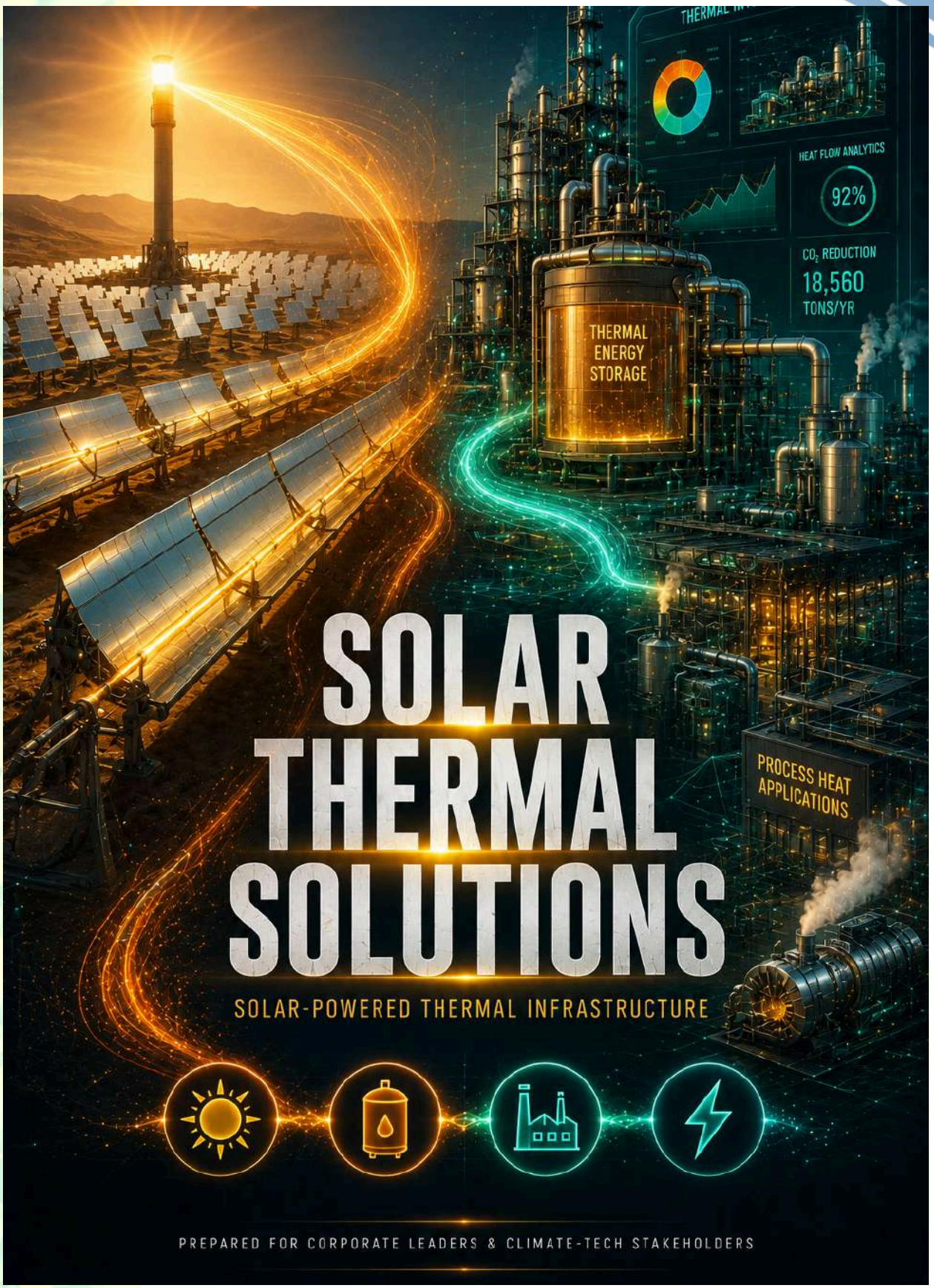
HEAT FLOW ANALYTICS
92%
CO_2 REDUCTION
18,560
TONS/YR
THERMAL ENERGY STORAGE
PROCESS HEAT APPLICATIONS
SOLAR THERMAL SOLUTIONS
SOLAR-POWERED THERMAL INFRASTRUCTURE
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

Solar & Wind

Solar Thermal Solutions

This section provides key inputs on India Solar Thermal Solutions Opportunities for corporate leaders

Opportunity Snapshot: Solar Thermal Solutions

Uses solar energy to generate heat for industrial and commercial applications.

Market Signal

- Adoption increasing in **food processing, textiles, chemicals, hospitality** industries
- Growth is driven by industrial decarbonisation and cost savings
- **Annual Market size by 2030:** 7000 - 8000 ₹ Cr

What Makes or Breaks It?

- Ability to deliver **consistent heat output** aligned with industrial processes
- **Customization capability** for sector-specific applications (textiles, dairy, chemicals)
- Strong ROI case (**payback period of 3–5 years)** for industrial clients

Why It Matters NOW?

- **Offers 20-40% reduction in cost** savings than fossil fuel heating; hence rapid adoption
- ESG and net-zero targets pushing **industrial heat decarbonisation**
- Policy support for renewable thermal applications (MNRE schemes)

Well Aligned Opportunity for

- **Industrial EPC players** (process engineering & thermal systems)
- **Boiler/heating equipment manufacturers** expanding into solar
- **Energy service companies (ESCOs)** offering heat-as-a-service models

Key Challenges

- Requires **site specific customisation**; hence longer sales cycle
- **Integration challenges** with existing industrial processes

Business Model

- Target high thermal demand sectors (textiles, food processing, pharma)
- Offer OPEX/ESCO models to reduce upfront cost barriers
- Integrate with existing heating systems (hybrid solar + conventional)

Introduction and Business Case

While solar PV dominates headlines, solar thermal solutions — from water heating to industrial process heat and concentrating solar power (CSP) — provide direct, efficient alternatives to fossil fuels. They address one of India's toughest challenges: decarbonising heat, which accounts for ~50% of industrial energy use. For households, solar water heaters cut electricity/LPG bills; for industries, solar thermal reduces dependence on coal, oil and gas while improving ESG compliance.

The growth of solar thermal solutions in India has been so far mediocre, with the exception of solar water heaters, especially when compared to that for solar PV. However, with India's high DNI (Direct Normal Irradiance) and industrial heat demand, solar thermal is a large, underexploited market, and one can expect significant growth in select application segments during the 2025-2035 timeframe.

Market Potential for Solar Thermal Solutions in India

Year	Market Size (₹ Cr)	Capacity Outlook	Drivers
2025	3,500-4,000	15-18 million m² collectors; CSP demos	Residential/commercial water heating, industrial pilots.
2030	7,000-8,000	30-35 million m²; industrial CSP scaling	Industrial process heat (food, dairy, textiles, pharma).
2040	20,000-25,000	80-90 million m² equivalent	Deep industrial decarbonisation; integration with storage.

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Utility-scale CSP power plants	Large solar power plants with day-night generation	Long-term PPAs, CfDs	Dispatchable renewable power
CSP with thermal energy storage	Solar power with 6–15+ hours storage	PPAs with firm power	Replaces fossil peaking power
Hybrid CSP + PV plants	PV + CSP for optimized LCOE & dispatch	Hybrid PPAs	Cost-optimized firm renewables

Industrial process heat (low–medium temp)	Steam, hot water (100–400°C)	Heat-as-a-service, long-term supply	Large untapped decarbonization market
High-temperature industrial heat	Cement, steel, glass, chemicals (>500°C)	Long-term supply contracts	Hard-to-abate sectors
Green hydrogen & e-fuels	Heat for electrolysis & synthetic fuels	Offtake-linked contracts	Strategic future energy vector
Desalination & water treatment	Thermal desalination processes	PPAs + water contracts	Water-energy nexus
Mining & remote operations	Off-grid power & heat	Captive plants	Fuel cost reduction
Solar thermal retrofits	Integration into existing plants	EPC + O&M	Asset life extension
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Typical Project Capacities & Investments Required in India

Project Type	Typical Capacity	Indicative CapEx (₹ Cr)	Notes
Industrial Solar Water Heating (flat-plate/ETC)	0.5-5 MWth	0.3-3.0	60-85 °C process hot water for F&B, textiles, pharma, hospitality.
Concentrated Solar Thermal (parabolic trough / linear Fresnel)	1-15 MWth	6-80	120-250 °C for dairies, pulp & paper, chemicals; steam up to ~15 bar.
Dish/Heliostat CST (high-temp point-focus)	0.5-5 MWth	4-30	200-500 °C for small-scale process heat, solar cooking, micro-CHP.
Solar Cooling (CST + absorption chiller)	0.5-3 MWth	5-25	Trigeneration for campuses, hotels, data halls with heat-led ops.
District Hot Water (residential campuses/hospitals)	1-10 MWth	1-8	Centralised SWH plants, thermal storage, insulated networks.
Solar Dryers (agro/industrial)	0.2-2 MWth	0.2-2.0	Hybrid dryers with thermal storage; reduces LPG/diesel use.
Thermal Storage Add-ons (molten salts/phase-change)	2-20 MWth	1-12	1-6 h storage to decouple heat supply from insolation.

Underlying Technologies & Processes

Element	Options	Key Traits
Collectors	Flat plate, evacuated tube, parabolic trough, Fresnel, dish	Determines efficiency and temp range (30°C-400°C+).
Applications	Water heating, steam generation, drying, cooking, CSP power	Household, commercial, industrial decarbonisation.
CSP technologies	Parabolic trough, solar tower, Fresnel, dish Stirling	Enables high-temp heat & power generation.
Thermal storage	Molten salts, phase-change materials	Extends availability beyond sunshine hours.
Hybridisation	Solar thermal + biomass, gas, or PV	Ensures reliability, wider adoption in industry.
Controls & monitoring	IoT sensors, SCADA integration	Optimises performance and lifecycle economics.

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Market Awareness & Demand Creation	Low awareness vs solar PV; perception as outdated technology; limited marketing and policy push	Slow market growth; longer sales cycles; difficulty scaling volumes	India policy focus heavily favors solar PV and electricity generation rather than thermal applications	Strong industry education, sector-specific targeting (hotels, hospitals, industrial heat), performance-based financing models
Competition from Alternative Technologies	Falling PV + heat pump costs; gas and electric heating alternatives; hybrid solutions emerging	Margin pressure; risk of substitution; uncertain ROI positioning	Cheap electricity in some states and subsidized fuels reduce adoption incentive	Position solar thermal for high-temperature industrial use, energy cost savings, and decarbonization mandates
Policy Support & Financing Constraints	Limited subsidies compared to PV;	Slower project closures; high upfront cost	Fragmented state policies and limited	Innovative financing (ESCO, OPEX models),

	lack of strong regulatory mandates; financing barriers for SMEs	sensitivity; scaling challenges	incentives for industrial solar heat	policy advocacy for industrial decarbonization incentives
Operational & Regional Challenges	Space requirements, installation complexity, water quality issues, maintenance gaps	Increased operational cost; performance variability; customer hesitation	High dust levels, water hardness, and varied climate zones impact performance	Region-specific design optimization, strong service networks, standardized O&M frameworks
Supply Chain & Capital Intensity	Specialized components (mirrors, receivers, storage systems); limited domestic manufacturing scale	High capex; longer payback; procurement risk	Smaller domestic ecosystem compared to PV; dependence on niche suppliers	Local manufacturing partnerships, modular designs, phased deployment strategies

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Tata Power Solar	Solar water heating and commercial systems.
Orb Energy	Industrial and commercial solar thermal solutions.
Thermax	Industrial solar thermal boilers, CSP integration.
Clique Solar	Pioneering concentrated solar thermal for industrial process heat.
Emmvee Solar Systems	Large-scale solar water heating systems.

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
From power generation to heat infrastructure	Solar-heat-as-a-service for industry	Unlocks massive non-power market
Thermal storage as a grid asset	CSP + molten-salt storage platforms	Replaces fossil peakers
Hybrid CSP–PV system design	PV + CSP hybrids for firm power	Competitive tariffs with reliability
Hydrogen & e-fuels enablement	Solar thermal heat for H_2, ammonia	Strategic future energy markets
Heat-as-a-Service (HaaS)	Long-term heat supply contracts	Predictable annuity revenues
Modular & scalable solar thermal	Modular industrial solar heat systems	Faster deployment, lower risk
Water-energy nexus solutions	CSP-powered desalination	Strategic infrastructure relevance
Retrofit & brownfield integration	Add-on solar thermal to plants	Lower risk than greenfield
Digital & AI-optimized heliostats	AI-controlled solar fields	Higher efficiency, lower O&M
Thermal-battery platforms	Standalone thermal energy storage	Cross-industry application

Concentric & Satellite Opportunities

- Industrial Heat-as-a-Service providers: Concentric ESCOs offering solar thermal and hybrid boiler systems under guaranteed-performance or pay-as-you-save contracts.
- Collector and receiver manufacturers: Local OEMs producing high-efficiency selective coatings, low-iron glass and durable mirrors or tubes suited for India's high-UV, dusty environments.
- Thermal storage system innovators: Makers of modular molten-salt or phase-change storage tanks extending solar heat usability into night operations.
- Solar cooling and trigeneration packages: Satellite integrators combining CST with absorption chillers for hotels, hospitals, data centres and airports.
- Digital MRV and analytics platforms: IoT-based tools measuring delivered heat (kWhth), uptime and emission savings for carbon credit and financing access.

- Solar dryer and agri-process equipment firms: Manufacturers supplying prefabricated hybrid dryers for food, spice and biomass clusters replacing LPG/diesel dryers.
- Parabolic trough tracker drives: Providers of linear actuators + sun-tracking controls for greater precision precision; 25% annual yield gain.

Key Takeaway for Senior Management

Takeaway	Details
Solar thermal addresses a decarbonization gap that electrification cannot easily solve	• Industrial process heat (80–400°C range) in food, textiles, chemicals, pharma, and dairy remains fossil-dependent. Solar thermal directly targets Scope 1 emissions • ***Example****:* Steam generation for dairy pasteurization or textile dyeing companies • **Implication:** Solar thermal is not competing with PV — it fills a structural gap in industrial decarbonization
The economics improve with fuel price volatility and carbon pressure	• Rising gas/diesel/coal prices and ESG-linked financing increase the attractiveness of renewable heat • ***Example****:* Industries exposed to CBAM or export ESG requirements increasingly seek renewable heat solutions • **Implication:** Solar thermal becomes a hedge against fossil fuel risk, not just an environmental investment
Integration capability is more valuable than hardware manufacturing	• Success depends on system design, storage integration, and industrial retrofitting — not just collector efficiency. • ***Sub-components****:* the need for key components such as thermal storage tanks, control systems, hybrid boiler interfaces, automation all comprise business opportunities • **Implication:** Engineering and integration expertise create higher margins than equipment supply
Hybridization is the pathway to reliability and scale	• Solar thermal alone is intermittent; hybrid systems ensure 24/7 industrial heat delivery • ***Examples****:* solar thermal + biomass backup, solar + electric boiler, solar + thermal storage • **Implication:** Bankable projects are hybrid energy systems, not standalone installations
Industrial clusters create scalable	• Concentrated industrial zones allow repeatable

platform opportunities	project deployment and lower customer acquisition cost • ***Example****:* Textile clusters, food processing parks, pharma zones • **Implication:** Cluster strategy beats one-off projects for investors
Advanced thermal storage integration	• High-efficiency storage enables load shifting and firm heat delivery • *Advantage:* increases uptime and customer confidence

Next Steps for Corporate Leaders

Solar thermal solutions are gaining renewed relevance as industrial and commercial users target decarbonization of low- and medium-temperature process heat. Applications across textiles, food processing, chemicals, pharma, and hospitality are now supported by maturing collector technologies, hybridization with boilers/heat pumps, and performance-based service models. As fuel volatility and carbon pricing increase, solar thermal offers a pathway to cost stability and Scope 1 emissions reduction.

This could be an attractive climate tech opportunity for industries and firms in specific sectors and industries keen on catering to this market.

Connect with Team EAI to know more about this opportunity and take your corporate's initial steps. Send a note to consult@eai.in or talk to Muthukrishnan - 9952910083