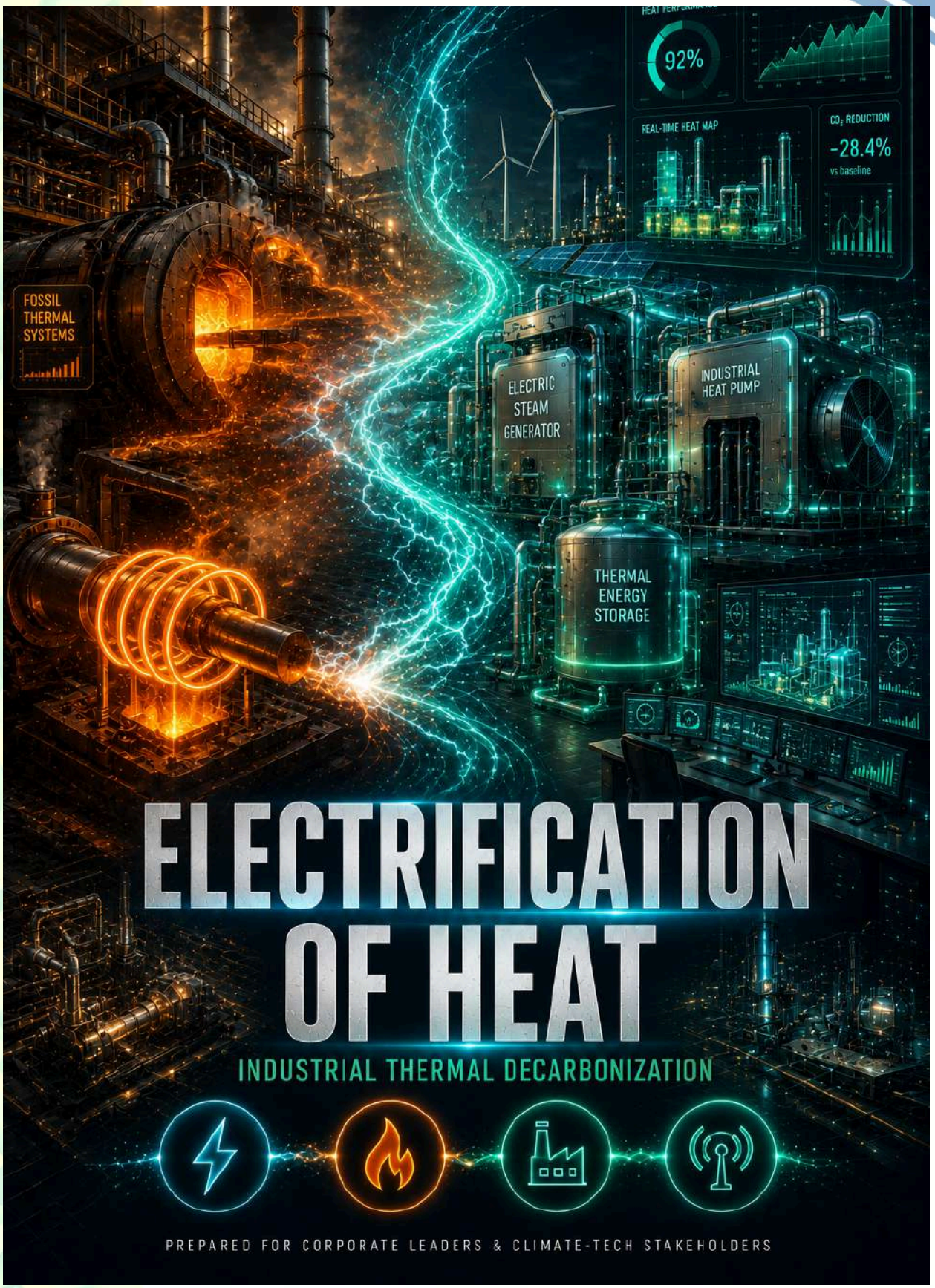
92%
REAL-TIME HEAT MAP
CO_2 REDUCTION
-28.4%
vs baseline
FOSSIL THERMAL SYSTEMS
ELECTRIC STEAM GENERATOR
INDUSTRIAL HEAT PUMP
THERMAL ENERGY STORAGE
ELECTRIFICATION OF HEAT
INDUSTRIAL THERMAL DECARBONIZATION
PREPARED FOR CORPORATE LEADERS & CLIMATE-TECH STAKEHOLDERS

Energy Efficiency & Digital

Electrification of Heat

This section provides key inputs on Electrification of Head Opportunities for corporate leaders.

Highlights

- Industrial and building heat accounts for a major share of fossil fuel use; electrification delivers deep Scope 1 emissions reduction
- Heat pumps (low–medium temp), electric boilers, induction heating, and emerging high-temperature heat pumps now cover a wide set of use cases
- Electrified heat pairs naturally with solar, wind, and storage, improving renewable utilization and grid flexibility
- Carbon pricing, fuel volatility, and net-zero commitments are pushing industries and buildings away from gas and coal

Key recommendations for corporate leaders include:

- Identify the top industries that have a need for this, that has feasible solutions and can afford it - an example could be the chemicals industry
- Overcome capex barriers with ESCO, BOOT, or shared-savings structures
- Combine heat electrification with process optimization, EMS, and demand response for maximum value

Opportunity Snapshot: Electrification Of Heat

Replace fossil-fuel-based heating with electric systems

Market Signal

- Increasing **adoption of heat pumps and electric boilers in industry**
- **Rising fuel costs** causing a shift toward electric heating solutions
- **Annual Market size by 2030:** 12,000 - 15,000 ₹ Cr

What Makes or Breaks It?

- **Selection of suitable tech** (heat pumps /electric boilers / induction) based on temperature needs
- **Integration** with existing processes without production disruption
- Access to low-cost electricity to ensure **operating cost advantage**

Why It Matters NOW?

- Decarbonisation of hard-to-abate industrial processes
- Improved efficiency: **heat pumps deliver 2–4x energy efficiency (COP)**
- Availability of renewable electricity enabling low-carbon heat

Well Aligned Opportunity for

- **Industrial equipment manufacturers** (boilers, heating systems)
- **Engineering/EPC firms** (process integration)
- **Energy service companies (ESCOs)**

Key Challenges

- **High upfront capex** for equipment replacement
- **Process compatibility issues** in high-temperature industries
- **Grid reliability and power availability** constraints

Business Model

- Retrofit fossil-based systems with electric heating solutions
- Target low/medium temperature industries (food, textiles, pharma)
- Offer ESCO/OPEX models to reduce upfront investment

Introduction and Business Case

Electrification of heat—using renewable electricity to power electric boilers, heat pumps, induction systems, infrared heaters, arc furnaces and other advanced thermal technologies—offers a transformational pathway to decarbonize India's industrial energy system. Coupled with India's rapidly falling renewable electricity prices and emerging green-power markets, electrified heat provides a practical, scalable alternative that can reduce emissions, improve efficiency and lower long-term operational costs.

With India's renewable energy boom, evolving regulatory landscape and industry demand for efficient decarbonization pathways, electrified heat is poised to become a cornerstone of the country's industrial transformation. Solution providers that act early will secure market leadership and economic competitiveness from providing solutions at scale, positioning themselves at the forefront of India's clean-energy future.

Market Potential for Electrification of Heat in India

(Estimates include all industrial and commercial heating applications that will use electricity)

Year	Market Size (₹ Cr)	Capacity Outlook (extra electricity demand)	Drivers
2025	6000 - 7,000	5 - 6 GW	Cost advantage emerging, strong regulatory push, early adopters demonstrating viability
2030	12,000 - 15,000	12 - 15 GW	Industrial electrification moves to scale, heat pumps and electric boilers become standard, high-temp pilots grow
2040	20,000 - 25,000	25 - 30 GW	Electrification becomes the dominant heating pathway for most sectors, high-temperature adoption becomes mainstream

Market Segments and Applications

Segment	Applications	Business Model	Key Drivers
Industrial High-Temperature Heat Pumps	Process heat (80–200 °C) for chemicals, food, paper	Equipment sales + long-term service contracts	Decarbonizing fossil-fuel industrial heat

Utility-Scale Power-to-Heat Systems	Electric boilers, grid-balancing heat for districts	EPC projects + heat supply contracts	Renewable integration and grid flexibility
Commercial & Campus Heat Pump Systems	Hospitals, airports, campuses, large buildings	CapEx + performance-based O&M	Rising gas costs and building decarbonization mandates
Residential Heat Pumps	Space and water heating	Product sales + installer ecosystems	Policy incentives and consumer electrification
District Heating Electrification	Large heat pumps, electric boilers for networks	Infrastructure projects + heat tariffs	Urban decarbonization and air-quality regulation
Hybrid Fossil-to-Electric Heat Systems	Transitional systems combining gas and electric	Equipment sales + optimization software	Phased decarbonization in legacy plants
Electrified Steam & Process Heating	Electric boilers, electrode boilers	EPC + service contracts	Steam demand without direct combustion
Heat Pumps with Waste Heat Integration	Upgrading industrial or data-centre waste heat	Project-based + shared-savings models	Improve efficiency and reduce energy costs
Digital Control & Optimization for Heat Electrification	Smart control of electrified heat assets	SaaS + lifecycle services	Manage power costs and grid constraints
Heat-as-a-Service Models	Outsourced heating with electrified systems	Long-term Opex / energy-service contracts	Lower customer capex and risk

Typical Project Capacities & Investments Required in India

Project Type	Typical Capacity	Indicative CapEx (₹ Cr)	Notes
Small	5 - 10 MW	20 - 50	Mix of heat pumps + electric boilers + induction
Medium	20 - 50 MW	130 - 325	Strong need for grid upgrades & PPA arrangements
Large	Upto 100 MW	600 - 1000	High impact on grid load, requiring dedicated feeders/substation expansion.

Underlying Technologies & Processes

Element	Options	Key Traits
Low Temp Heat (<120°C)	Used in Textiles, FMCG, Food processing, Pharmaceuticals, Dairy, Paper, Distilleries	Highest efficiency, High speed, low thermal inertia, Faster heating
Medium Temp Heat (120-400°C)	Used in Chemicals, Pharma, Textiles, FMCG, Auto, Refineries, Food, Plastics	Rapid start-up, highly modular, High control precision, Suitable for retrofits or localised heating
High Temp Heat (400-1,600°C)	Used in Steel, Foundry, Glass, Ceramics, Cement, Metals, Heavy Manufacturing	High energy efficiency at scale
Thermal Energy Storage (TES), Automation	Delivers stable heat, VFDs, SCR controllers, PLC/SCADA systems	Peak-load management, precision heating, reduced losses
Waste Heat Recovery (WHR), Heat Pumps	Combines waste-heat upgrade with electrified systems	Best fit for chemicals, refineries, cement and steel plants

Key Challenges

Challenge Area	Key Issues	Business Impact	India Specific	Strategic Implications
Capital Requirements & Financing Barriers	Significant upfront investment for electrification equipment and infrastructure upgrades	Longer payback periods impacting investment decisions	Limited financing structures for industrial decarbonization upgrades	Energy-as-a-service or performance-based financing models needed
Electricity Cost vs Conventional Fuels Economics	Electrified heat must compete with coal, gas, and biomass on cost	Slow adoption if operating costs increase	Industrial electricity tariffs often high; cross-subsidy structures	Need renewable integration (RE PPAs/captive solar) to improve economics
Grid Reliability & Power Availability	High-temperature industrial processes require	Operational risk if power quality or uptime is inconsistent	Regional grid stability differences; peak demand	Hybrid solutions with storage or backup systems required

	continuous heat supply		constraints	
Technology Readiness & Process Integration Complexity	Retrofitting electric boilers, heat pumps, induction heating into existing plants	Higher engineering costs and operational uncertainty	Aging industrial infrastructure; sector-specific heat requirements	Pilot projects and modular deployment strategies important
Supply Chain & Policy/Geopolitical Risks	Dependence on imported components (power electronics, advanced heat pumps)	Cost volatility and deployment delays	Localization mandates, currency fluctuations, evolving policies	Supplier diversification and local manufacturing partnerships critical

Prominent Players in the Indian Market

Company / Entity	Focus Areas
Thermax Ltd	Electric boilers, heat pumps and industrial steam solutions
SAZ Boilers	Electric and steam boiler systems, industrial boilers, heat exchangers
Voltas (Tata Group)	Heat pump and HVAC portfolio
LG Electronics India	Heat pumps and HVAC systems relevant for electrified heat
Inductotherm Group India	induction melting/heating equipment
Electrotherm - Engineering & Technologies	Advanced induction melting & heating solutions, especially for steel and foundries
Thermax Ltd	Beyond boilers, engages in turnkey infrastructure and thermal electrification projects
Larsen & Toubro (L&T)	Major electrical cables and components supplier critical to electrification projects

Innovation Perspectives

Innovation	Business Opportunity	For Senior Management
Heat-as-a-Service Platforms	Provider owns electrified heat systems and sells heat outcomes	Creates long-term, infrastructure-like revenues
High-Temperature Electrification Breakthroughs	Modular, scalable ultra-high-temp heat pumps	Unlocks hardest-to-abate industrial emissions
Power-Heat-Grid Co-Optimization Software	AI-driven optimization across electricity, heat, and storage	Converts cost volatility into competitive advantage
Waste-Heat-to-Electric-Heat Loops	Closed-loop systems upgrading waste heat electrically	Step-change efficiency and carbon reduction
Electrified Steam-as-a-Service	Outsourced electric steam with performance guarantees	Addresses large, conservative industrial markets
Carbon-Indexed Heat Contracts	Heat priced on €/MWh and €/tCO_2 avoided	Enables premium pricing and compliance alignment
Hybrid Transition Architectures	Smart hybrid systems optimized over time	De-risks customer transition pathways
District Heat Electrification Ecosystems	Integrated city-scale power-to-heat platforms	Captures policy-backed, long-duration demand
Standardized Electrification Retrofit Kits	Plug-and-play electrified heat modules	Mass-market scalability beyond bespoke projects
Electrification + Financing Bundles	Embedded financing tied to energy savings	Accelerates adoption and deal velocity

Concentric & Satellite Opportunities

- High-Temperature Industrial Heat Pump (HTHP) OEMs: Providers developing high-efficiency, multi-stage heat pumps that can reliably deliver industrial steam and hot water up to 160C (and beyond), replacing medium-temperature fossil fuel boilers.
- Modular Thermal Energy Storage (TES) Solutions: Concentric suppliers offering advanced TES systems (e.g., molten salt, ceramics, phase change materials) to decouple electric heating from peak grid hours, enabling consumption of low-cost renewable power.

- Compact Electric Boiler and Heater Integration: OEMs specializing in highly compact, high-pressure electric steam boilers and resistance/induction heating elements for flexible, direct insertion into existing low-to-medium temperature process lines.
- Advanced Refrigerant and Component Manufacturing: Manufacturers focused on developing and scaling environmentally benign, high-performance refrigerants (e.g., natural refrigerants like CO2 and specialized, quiet compressors for heat pump systems.
- Waste Heat Recovery and Re-use Systems: Heat exchanger and pump providers focused on systems that capture low-grade waste heat from industrial processes or data centers and efficiently upgrade it using heat pumps for re-injection into the process or district heating networks.
- Heat-as-a-Service (HaaS) Providers: Companies offering long-term contracts for the installation, financing and maintenance of electrified heating systems (e.g., heat pumps, electric boilers), eliminating high upfront capital costs for the end-user.
- Building Energy Management Systems (BEMS) and Digital Twins: Software platforms integrating electrified HVAC, solar PV and storage to create a holistic Digital Twin of the building's thermal and electric flows, ensuring optimal, lowest-cost operation and comfort.

Key Takeaway for Senior Management

Takeaway	Details
Electrification of heat is a core industrial transformation lever, not a fuel swap	• It reshapes cost structures, carbon exposure, and operational flexibility—especially for Scope 1 emissions • ***Examples****:* industrial heat pumps replacing gas boilers; electric furnaces in food/textiles; electrified district heating • **Recommended innovation focus:** system redesign around electricity, not one-to-one equipment replacement

Temperature segmentation determines economics and scalability	• Returns depend on matching technology to heat grade and duty cycle
	• **Sub-components:**
	  • Low–medium temp (≤200°C): industrial heat pumps
	  • Medium temp: electric boilers, resistive heating
	  • High temp (emerging): high-temp heat pumps, hybrid electric systems
	Competitive advantage: higher COP, faster payback, and broader applicability than single-tech approaches

Power cost, flexibility, and grid integration are decisive success	• Electrified heat is only competitive when electricity is optimized

factors	• ***Examples**:* behind-the-meter solar, hybrid RE + BESS, demand response, time-of-use optimization • **Recommended innovation focus:** smart load management and flexible electrified processes
Outcome-based solutions and models accelerate adoption and scale	• Capex sensitivity remains high in industrial heat • ***Examples**:* ESCO/BOOT models, electrification-as-a-service, shared savings • **Competitive advantage:** faster deal flow and infrastructure-like recurring returns

Next Steps for Corporate Leaders

Electrification of heat is emerging as a key lever for industrial decarbonization as corporations seek to replace fossil-based boilers, furnaces, and process heat systems with heat pumps, electric boilers, induction heating, and other electric thermal technologies. As power grids decarbonize and carbon pricing tightens, electrified heat pathways offer both emissions reduction and operational efficiency benefits for low- and medium-temperature segments, while high-temperature applications continue to advance through emerging solutions and hydrogen/e-fuel hybrids.

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