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Corporate heat adaptation and mitigation strategies

April 2026

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Foreword



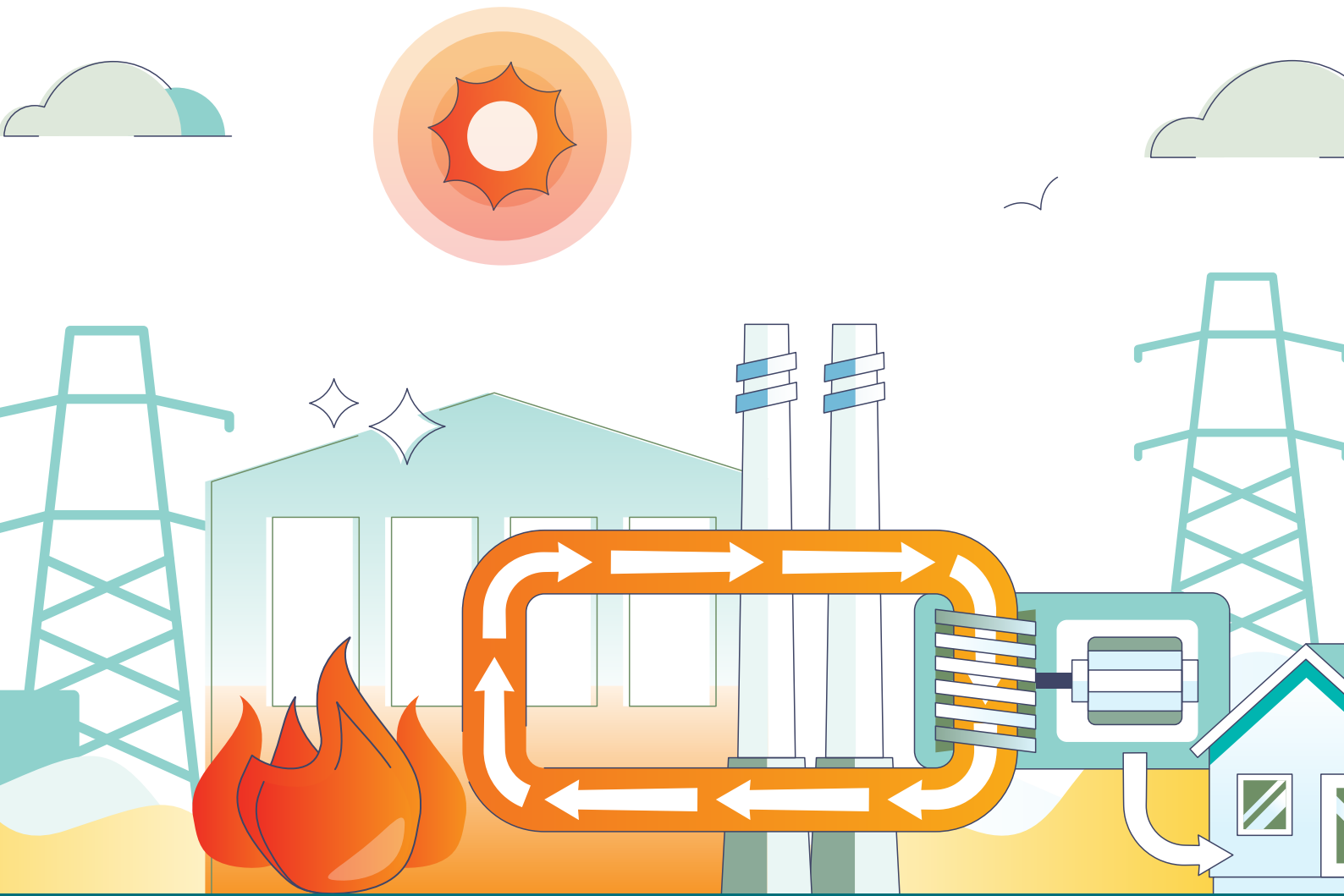
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Rising temperatures, rapid urban growth and increasing demand for cooling are transforming heat from a background environmental factor into a structural business risk. Record-breaking summer temperatures and expanding city footprints are now amplifying exposure across workers, assets and core operations.

This paper focuses on potential pathways for companies across industries, beginning with people-first actions that cut immediate heat exposure, aligning governance with public alert systems and investing in medium-term resilience across infrastructure, operations and technology. It also maps public policy to corporate governance, translating national codes, state heat action plans and municipal programmes into actionable steps and board-level priorities.

Organisations must move beyond reactive heatwave crisis management and adopt proactive, portfolio-wide strategies that protect workers, preserve productivity, and mitigate energy and compliance risks. With most of India's 2050 urban infrastructure yet to be built, today's decisions will shape local climate conditions for decades to come. Now is the time for business leaders to work alongside government, civil society and industry organisations to expand blue-green infrastructure and invest in resilient solutions, technologies and data-driven strategies.





Escalating heat stress and India's rising vulnerability

Global warming is now a proven phenomenon, driving significant and measurable changes in the climate and environment worldwide. 2024 shattered heat records worldwide, becoming the first year where the planet's average temperature rise crossed the critical 1.5 °C threshold. Remarkably, every one of the last ten years ranks among the hottest in history, underscoring a persistent and accelerating trend of planetary warming.¹

India is the country most affected by heat-stress-driven productivity loss, according to the International Labour Organisation (ILO). India has about one-sixth of the world's population but accounts for nearly one-third of global labour-hour losses from extreme heat, about 180 billion out of 500 billion hours, showing a highly disproportionate heat impact.^{2,3} Heat also poses a rising public health burden in India. In 2024 alone, authorities recorded 48,156 suspected cases and 161 confirmed deaths due to extreme heat.⁴



Heat severity, intensity and frequency are all rising rapidly in India.

Heat stress is intensifying across India, driven by increasingly frequent and prolonged heatwave episodes. Research on the post-1980s period reveals a steady rise in extreme heat events, with an average increase of 12 heatwaves and 5 severe heatwaves per decade.⁵ India Meteorological Department (IMD) data show that since 1961, heatwave intensity, measured by maximum temperatures during these events, has increased across North and Northwestern India, with rises ranging from 0.2 °C to 0.3 °C per decade. IMD projects that under the current scenario, the projected frequency of heatwaves will double, the duration of heatwaves will increase by 8–12 days/season and the intensity by 2–3°C by the end of the century.⁶ India faces structural exposure to heat stress across rural, urban, and industrial areas, driven by extreme pre-monsoon conditions, high humidity in many regions, rapid urbanisation, and a large proportion of outdoor and non-AC work. However, the burden is disproportionately higher in urban and industrial zones, where dense built environments, limited green cover, high waste heat from industry and transport and heat-trapping materials amplify temperatures.

This elevated urban burden is further intensified by the Urban Heat Island (UHI) effect, under which dense, built-up areas consistently experience higher temperatures than surrounding rural regions. Heat-retaining materials such as asphalt and concrete, along with dark roof surfaces, absorb solar energy during the day and release it slowly at night, reducing nighttime cooling. Compact urban layouts restrict air movement and natural ventilation, while anthropogenic heat from traffic, industrial activity and air-conditioning systems further raises local temperatures. Consequently, urban areas experience sustained elevated temperatures, especially during evenings and nights, extending heat exposure and intensifying risks to health, productivity, and energy infrastructure.^{7,8}

While targeted urban design and planning interventions can significantly mitigate Urban Heat Island (UHI) impacts, current urban development patterns in India continue to intensify UHI through a combination of land-use change, built-form choices and rising anthropogenic heat.

Decline in green and blue infrastructure: Rapid urban expansion and concretisation have reduced trees, parks, lakes and canals, eroding cities' natural cooling through shade and evapotranspiration. As green and blue cover shrinks, urban areas lose an important buffer against rising temperatures, amplifying local heat stress. Major Indian cities reflect this trend. In Ahmedabad, a study projects green cover could shrink to just about 3 percent of the city's area by 2030, while

Kolkata has already lost nearly 30 percent of its tree and vegetation cover between 2011 and 2021.^{9,10}

Heat-trapping urban fabric: As cities grow, permeable surfaces are replaced by asphalt, concrete and dark roofs that absorb and store heat during the day and release it slowly at night. Compact layouts and "urban canyons" restrict air flow, limiting cooling and amplifying these heat-retention effects.

Anthropogenic heat and self-reinforcing demand cycle: Heat released from vehicles, industry and air-conditioning systems directly raises urban temperatures, especially during heatwaves. With residential AC units projected to increase from ~90 million in 2024 to ~350 million by 2037,^{11,12,13} rising cooling demand is creating a self-reinforcing feedback loop that further elevates waste heat and grid stress.

The effects of the UHI can be seen in various Indian cities. Night time urban-rural temperature gaps of ~3–5°C have been seen in cities such as Delhi, Chennai, Surat and Lucknow.^{14,15} Even within a single city, there can be stark differences due to variations in green/blue cover and urban form. In Mumbai in March 2025, Powai was ~13°C cooler than Ghatkopar.¹⁶

For Indian businesses, extreme heat has transitioned from an environmental challenge to a systemic operational risk. Intensifying temperatures, magnified within dense urban and industrial workplaces, are exposing workers to unsafe conditions, leading to productivity losses, increasing cooling and energy costs and accelerating equipment degradations. Recognising and proactively addressing these impacts is now critical for organisations to protect their workforce, sustain operational continuity and safeguard long-term performance.

India's urban population is set to nearly double from ~530 million in 2024 to ~950 million by 2050. This means that a larger number of people will be exposed to the exacerbating effects of UHI. A large portion of the urban and industrial infrastructure supporting GDP growth under Viksit Bharat 2047 is yet to be built. This is a critical inflection point, as design, materials and planning decisions made today will shape urban climate conditions for decades. If approached strategically, this build-out represents a major opportunity to embed heat-resilient, people-centric urban design that reduces future productivity losses, health risks and energy demand while supporting sustainable economic growth.^{17,18}

Impact of heat on corporates and workforce

Rising heat stress impacts businesses in multiple, compounding ways, with workers exposed to heat being the most vulnerable. Global warming, India's inherent climate exposure and the intensifying UHI effect combine to make operating environments significantly hotter. For businesses, heat drives a range of operational and financial risks, affecting workforce productivity and recovery, disrupting operations, straining electricity reliability, elevating operating costs and tightening regulatory compliance expectations related to heat exposure.

Workforce productivity and health risks

Higher temperatures reduce worker output and prolong recovery. A national-level study of Indian factories finds that annual plant output declines by ~2 percent for every +1 °C rise in annual temperature. It also shows that the lack of effective cooling worsens productivity losses. In labour-intensive industries, this translates into lower throughput, higher defect rates and elevated overtime requirements during hot periods.¹⁹



Cooling demand, peak tariffs and grid strain

Rising heat is driving electricity demand to unprecedented levels, with India's power system recording an all-time peak of approximately 250 GW in FY2024–25, underscoring sustained structural growth fuelled by expanding cooling loads and broader economic activity.^{20,21} Looking ahead, national peak power requirements are projected to exceed ~366 GW by 2031–32,²² indicating sustained pressure on generation capacity, transmission networks and tariff structures. The incremental load for every +1 °C rise in daily temperature now exceeds 7 GW, compared with ~3.5 GW in 2019, indicating that temperature sensitivity has nearly doubled over time. This heightened demand increases the risk of outages and system failures, while pushing up operating expenses for commercial and industrial users due to peak tariffs and greater generator-fuel use, especially in dense urban areas.^{23,24,25}



Asset degradation, maintenance and logistics disruption

Equipment performance reduces, and the probability of failure increases as temperature goes up.^{26,27} AC efficiency is reduced by ~30 percent when the ambient temperature increases from 27 °C to 45 °C.²⁸ Moreover, most conventional split and window air-conditioning systems are tested and rated for operation up to ~45°C outdoor temperatures. At higher ambient temperature conditions, cooling capacity and efficiency decline sharply, and systems increasingly operate outside optimal design envelopes, raising the likelihood of derating, protective shutdowns and equipment stress.^{29,30,31,32} These aspects increase equipment downtime, maintenance and increase capex requirements (need for larger/forced cooled units). The Indian Railways also prescribes temporary speed restrictions on long welded rails when rail temperatures exceed set thresholds.³³ Railway guidelines highlight degradation risks at high pavement temperatures, implying higher Overhead & Maintenance (O&M), slower freight and last-mile speeds in city areas during times of high heat.³⁴ These stresses on the railway system create issues with the supply chain and logistics for businesses.



Although heat-related risks span the economy, their business impacts are distributed unevenly. Specific sectors exhibit materially higher vulnerability to rising temperatures:

Construction and real estate

Construction is highly vulnerable to increasing heat, with most of the work occurring outdoors where the worksites are directly exposed to the sun. The worksites also cool down more slowly at night due to the UHI effect. Research from China indicates productivity in construction declines by ~0.57 percent for every +1 °C rise in WBGT (Wet-Bulb Globe Temperature).³⁵

Retail, hospitality and tourism

Extreme heatwaves are hitting India's tourism economy. In Agra, when temperatures touched ~45°C in May 2024, daily visitors at the Taj Mahal fell from the usual 25,000–30,000 to

~12,000–15,000, with about 100 tourists needing help for heat-related illness in a single month.³⁶ In Rajasthan (May–June 2024), the heatwave pushed hotel occupancies in leading chains down to about 20–25 percent, compared with roughly 50 percent a year earlier. As big hotels slashed tariffs by 75–80 percent, many smaller properties faced days with very low bookings.³⁷

Healthcare and temperature-sensitive medical supply chains

Temperature-control failures are a major source of loss in healthcare logistics in India, with ~20 percent of temperature-sensitive medical products and ~25 percent of vaccines lost due to cold-chain breakdowns, resulting in ~US\$313 million in annual losses.³⁸ Rising heat increases the risk of temperatures exceeding safety limits driving higher storage and energy costs, greater waste, returns and write-offs and elevated regulatory and compliance exposure.



Workforce vulnerability varies by exposure environment

Workers remain at the frontline of heat exposure, and the degree of impact varies sharply by where and how the work is performed. Targeting mitigation effectively across job categories requires a systematic assessment of working conditions.

Heat exposure is shaped not just by temperature, but by where work happens, how long exposure lasts and how much physical effort is involved. Exposure conditions differ sharply across occupations, ranging from continuous outdoor work

under direct sun to enclosed indoor environments with poor ventilation to roles that require frequent movement between indoor and outdoor settings.

In many jobs, especially in services and logistics, workers repeatedly shift between cooled or shaded spaces and extreme outdoor heat. As a result, health risks depend not only on peak temperatures, but on the pattern, intensity and continuity of exposure across the workday.

Outdoor workers (Highest exposure risk)

These workers spend the majority of their time in open, unenclosed areas under direct sun, intense radiant heat from paved and built surfaces, and additional waste heat from traffic, HVAC exhaust and industrial activity. This group includes farmers, maintenance technicians, traffic police, delivery riders, sanitation staff, waste collectors, utility and maintenance crews, street vendors and kiln workers.

Many workers, especially in the informal sector, lack access to shaded rest areas with adequate

hydration and sanitation facilities while working long, physically demanding shifts, affecting their health and productivity. Exposure risks are further amplified for workers in non-AC transport environments, where bus interiors can run 5–10 °C hotter than outdoors in summer.³⁹ A South India study (~2,000 workers) found that outdoor workers had 2.1× higher odds of heat-related symptoms and 11.4× higher odds of productivity loss compared with indoor workers.⁴⁰



Mobile field workers (Mixed exposure profile)

These workers routinely move between outdoor conditions and enclosed indoor settings across the workday (with or without cooling). They include construction workers, logistics and last-mile workers, FMCG sales agents, collection agents, security guards (in certain roles) and on-site service staff. In some cases, workers bring children to worksites due to a lack of

caregiving alternatives, and the heat exposure implications for these children remain under-examined.

This constant transition between indoor spaces and high outdoor temperatures places additional cardiovascular and thermal stress on the body, increasing dehydration and recovery times.



Indoor workers (Non-AC enclosed heat burden)

These workers spend most of their time indoors, but often in cramped, poorly ventilated, non-AC spaces or heated environments such as cabins or vehicle compartments. This group includes factory workers, warehouse staff, small shopkeepers and cottage-industry labour.

Thermal stress can remain severe even indoors, with glass plants reporting Wet-Bulb Globe

Temperatures (WBGT) of about 40 °C near furnaces, and small foundries recording WBGT levels of ~34 °C, associated with productivity losses of 40–50 percent in the hottest sections.^{41,42,43,44,45}

As cities and workplaces grow denser, indoor heat will continue to rise unless cooling, insulation and ventilation improvements are prioritised.

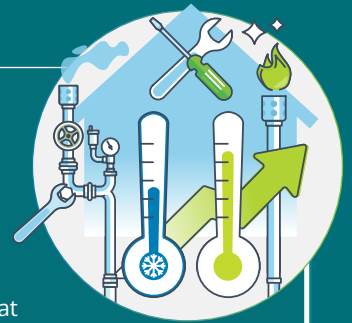
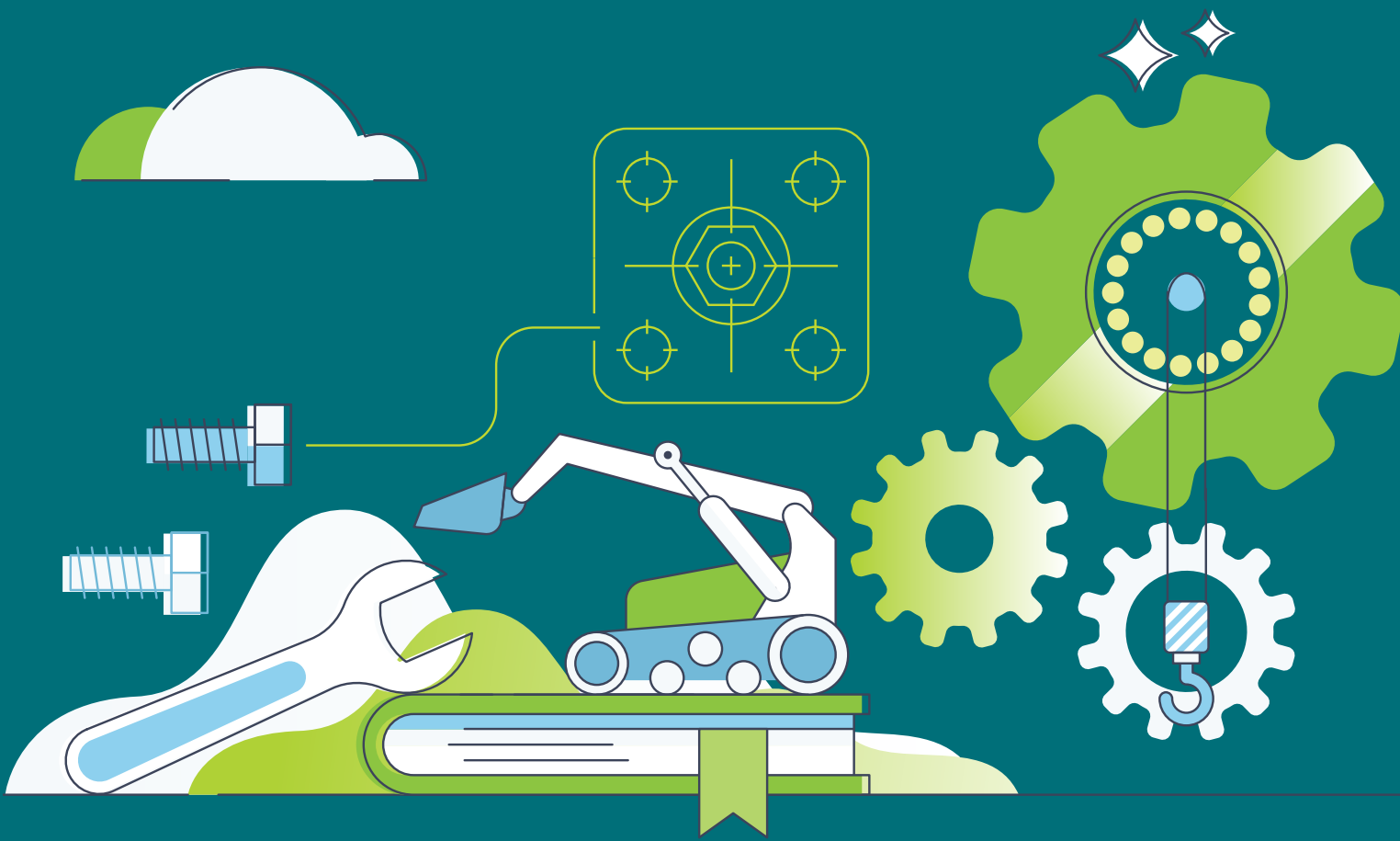
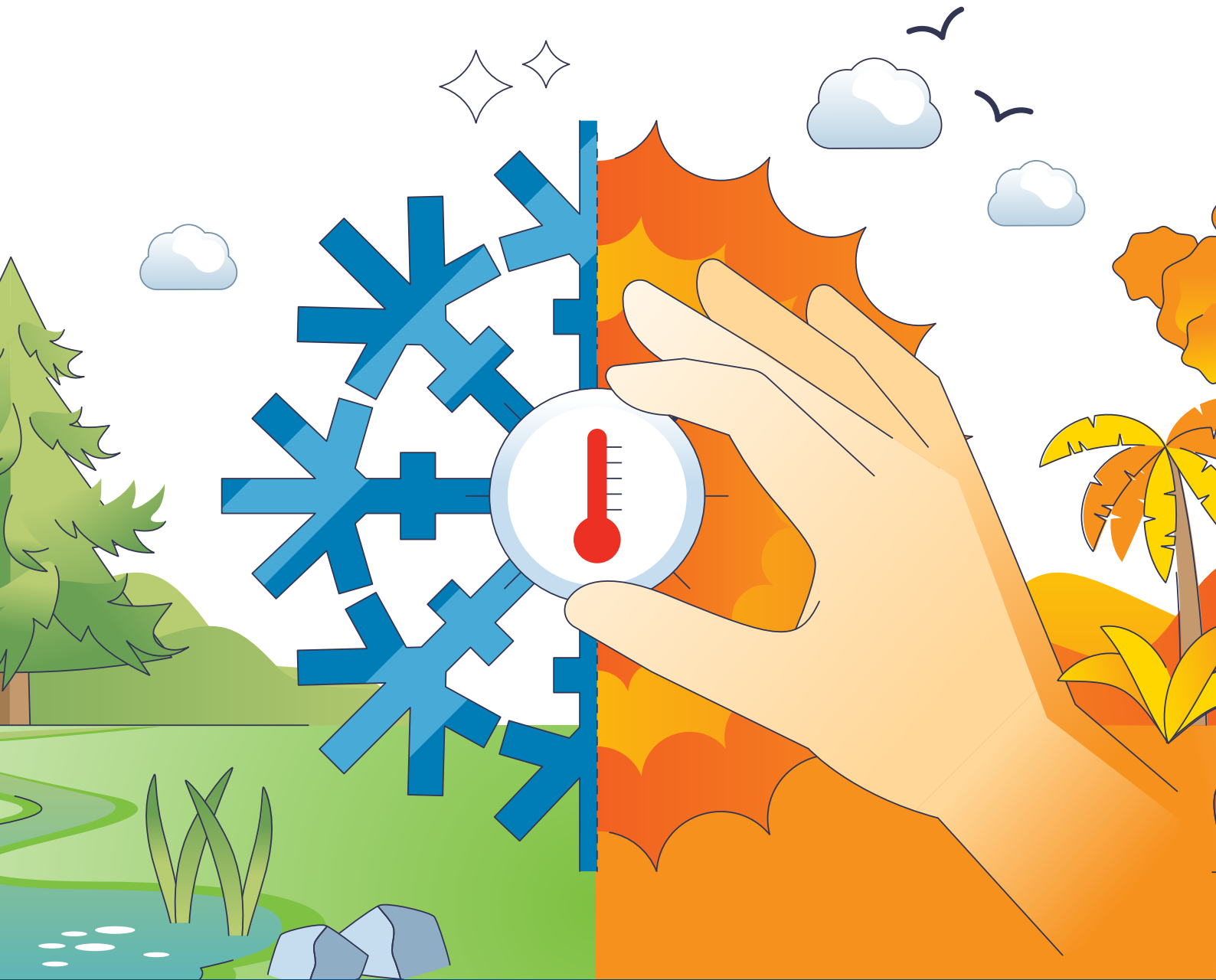


Table 1: Representative worker archetypes and illustrative occupational examples

Category	Examples
Outdoor workers	Farmers, security guards (in many cases), delivery drivers, road crews, utility technicians, etc.
Mobile field workers	Construction workers, logistics workers, Sales representatives, collection agents, etc.
Indoor workers	Factory workers, warehouse workers, kitchen staff, etc.

Because heat affects worker groups so differently, a heat-exposure segmentation is essential for designing fair and effective mitigation strategies. Categorising workforces by their exposure profile, continuous outdoor work, mixed indoor-outdoor movement or enclosed non-AC environments helps organisations tailor actions to the risks that truly matter on-ground. This targeted approach ensures that the most vulnerable roles receive the strongest protections, while operational resources are deployed where they deliver the greatest impact.





Way forward: Building heat resilience in India

While many organisations have begun initial actions, lasting resilience requires layering physical, digital, governance and ecosystem solutions into a unified heat-management strategy. Building on the progress already underway, the priorities below outline how organisations and cities can systematically move from tactical relief to structural, long-term heat resilience.



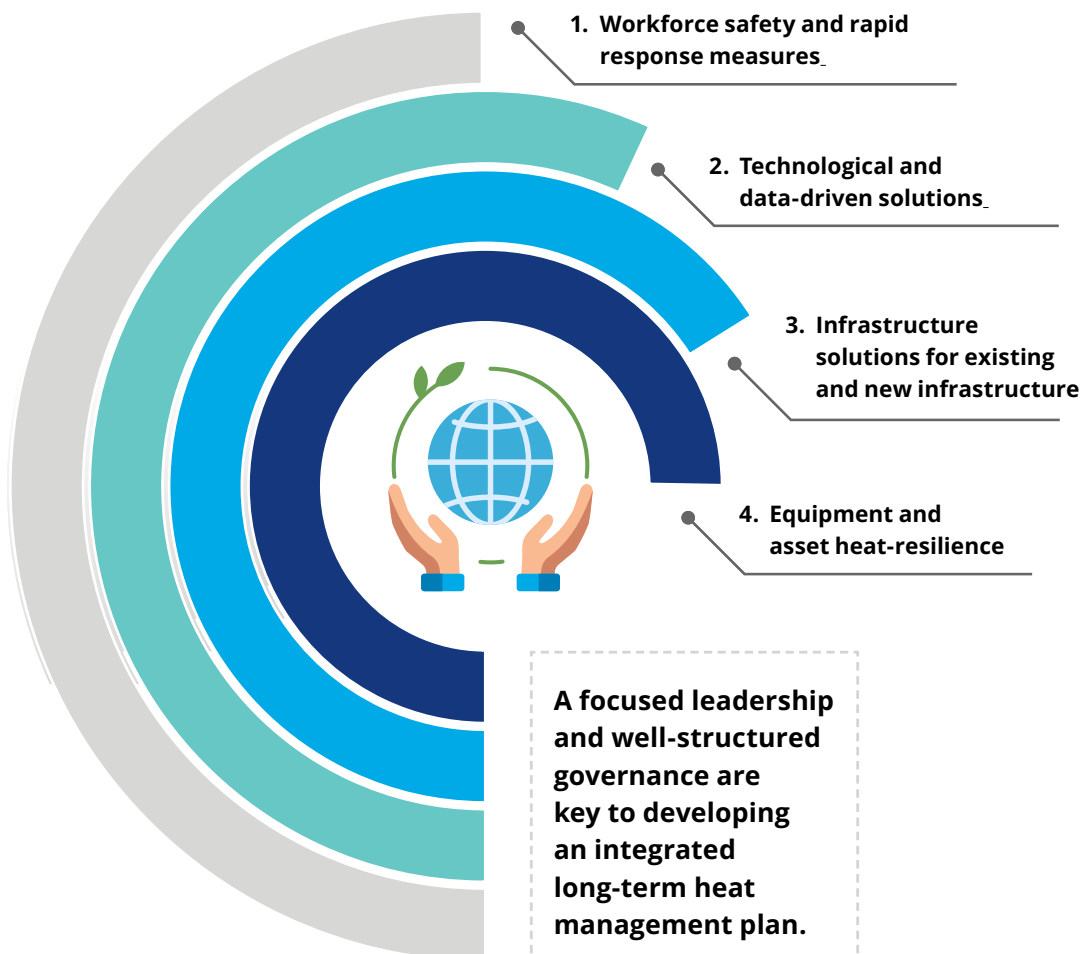
To translate this integrated ambition into sustained on-ground impact, strong internal governance and tone from the top are indispensable. Heat resilience cannot be treated as a site-level operational issue alone; it must be owned at the board and senior management level so that budgeting, resourcing, HR, administration, procurement and manufacturing operations are fully aligned behind a common heat-risk mandate. Dedicated funding is especially critical; without assured budgets, even the most well-designed heat interventions remain infeasible or unevenly implemented.

Without this leadership anchor, measures across operations, infrastructure, technology and the workforce risk being fragmented and inconsistently applied.

Governance and risk-management systems are the primary drivers that enable infrastructure upgrades, technology-driven controls and equipment resilience to deliver sustained, long-term return. Institutionalising heat

governance through Heat Safety Committees, dedicated Heat Safety Officers and clearly defined SOPs ensures that interventions translate into accountable decision-making and safer operating conditions across all sites. Clear roles, escalation protocols and reporting lines preserve accountability at every level. Hydration and recovery points must be strategically planned and supported by structured worker behaviour change programmes. Real-time dashboards aligned with public heat alerts enable rapid operational response, while pre-season heat-risk mapping, in-season spot checks and post-season audits drive continuous improvement through structured reporting to governance bodies.

With this governance foundation in place, organisations can progress from immediate workforce protection to deeper infrastructure upgrades, technology-enabled controls and long-term asset resilience in a coordinated and sustained manner.



1. Workforce safety and rapid response measures

Effectively addressing heat stress requires moving beyond reactive responses to immediate, on-ground protection for workers and operations. Many organisations have already initiated practical first steps to reduce direct heat exposure and stabilise site conditions during extreme temperatures. The following suggested actions focus on rapid deployment, low capital intensity and immediate risk reduction, forming the frontline of operational heat resilience:



Mandatory rest breaks and designated recovery spaces, with flexible shift timings during peak heat



Upgrade ventilation in heat-intensive indoor areas to improve air circulation



Ensure uninterrupted access to mobile hydration stations with drinking water and locally relevant options (for example buttermilk and lemonade)



Deploy insulated roofs and high-SRI reflective coatings to lower roof and indoor surface temperatures



First-aid readiness for heat-specific emergencies



Awareness activities and visual materials in regional languages



Establish temporary and permanent shade structures (rest and recovery points) across worksites and operational zones



Implement a “Heat Warriors” programme to catch heat illness early and respond fast. Implement a buddy system (peer monitoring) for high-risk workers, including scheduled hydration and symptom checks. Keep compliance logs and review them each week

2. Technological and data-driven solutions

Technology enables organisations to manage heat more precisely by pairing smarter cooling systems with real-time data. These solutions optimise energy use, reduce peak loads and help maintain stable thermal conditions to protect workers and equipment from heat stress.



Deploy smart HVAC systems and grid-linked smart thermostats to enable organisations to optimise cooling schedules



Implement AI and IoT-based monitoring for real-time ambient, occupancy and equipment data



Use automated building controls to manage ventilation and reduce cooling demand during peak heat



Integrate systems into site dashboards for rapid decision-making during alerts



Scale efficient cooling using Cooling-as-a-Service (CaaS) and utility demand-side management programmes through performance-based contracts with metered savings to reduce system peaks

3. Infrastructure solutions for existing and new infrastructure

Infrastructure measures can be grouped into two types:



Modifications to existing infrastructure



Changes during the planning and design phases for new infrastructure



The first focuses on retrofitting and upgrading current facilities to quickly reduce heat exposure, while the second embeds heat resilience into future planning and design stages for new infrastructure for long-term impact. Together, they enable organisations and cities to transition from reactive relief to structural and lasting cooling solutions.

Measures for existing infrastructure:



Apply high-albedo/high-SRI coatings to large sheds and top floors



Add insulation such as Alu-foil under metal roofs and wood-wool false ceilings to reduce radiant heat and lower indoor temperatures



Install temporary shade along routes and work fronts



Deploy compact Phase-Change Material (PCM) systems to shave peak cooling loads



Add solar-shade canopies in parking, loading and on top of warehouses



Restore ponds and lakes, create sponge parks and convert impervious surfaces to permeable paving to reduce surface heat



Retrofit green roofs and vertical greening for heat insulation and evaporative cooling where the structure allows



Establish community cooling hubs with municipal bodies and civil society



Deploy sprinkler systems as part of infrastructure retrofits to regulate ambient temperatures



Measures for new infrastructure:



Embed heat resilience in master plans by limiting paved area, prioritising pervious surfacing and specifying high reflectance materials for roofs and pavements



Incorporate site-level green infrastructure using native species, shaded corridors and passive cooling landscapes within factory premises



Integrate canopy corridors, shaded walkways and pocket parks into circulation planning



Use lime-based construction for natural insulation and reduced cooling demand



Install rooftop solar on ventilated mounts to provide both shade and energy



Implement Aquifer Thermal Energy Storage (ATES) to store excess summer heat in the ground and use this stored heat in winter and vice versa to deliver high-efficiency heating and cooling for large facilities



4. Equipment and asset heat-resilience

Building resilience into machinery and equipment ensures operational continuity during extreme heat. Strengthening mechanical systems, improving maintenance practices and enhancing procurement standards reduce heat-related failures and extend asset life.



Identify machinery most sensitive to heat and prioritise upgrades accordingly



Schedule heavy equipment operations for cooler hours and update maintenance contracts to strengthen operational resilience



Install sensors to monitor temperature, vibration and electrical load for condition-based maintenance



Update procurement standards to require vendor performance at elevated temperatures



Improve condenser and heat-exchanger design, use high-efficiency compressors and add Variable Frequency Drives (VFDs) to help maintain performance under higher temperatures



Update procurement standards to require vendor performance at elevated temperatures



Enhance insulation for critical equipment and shaded positioning of outdoor units



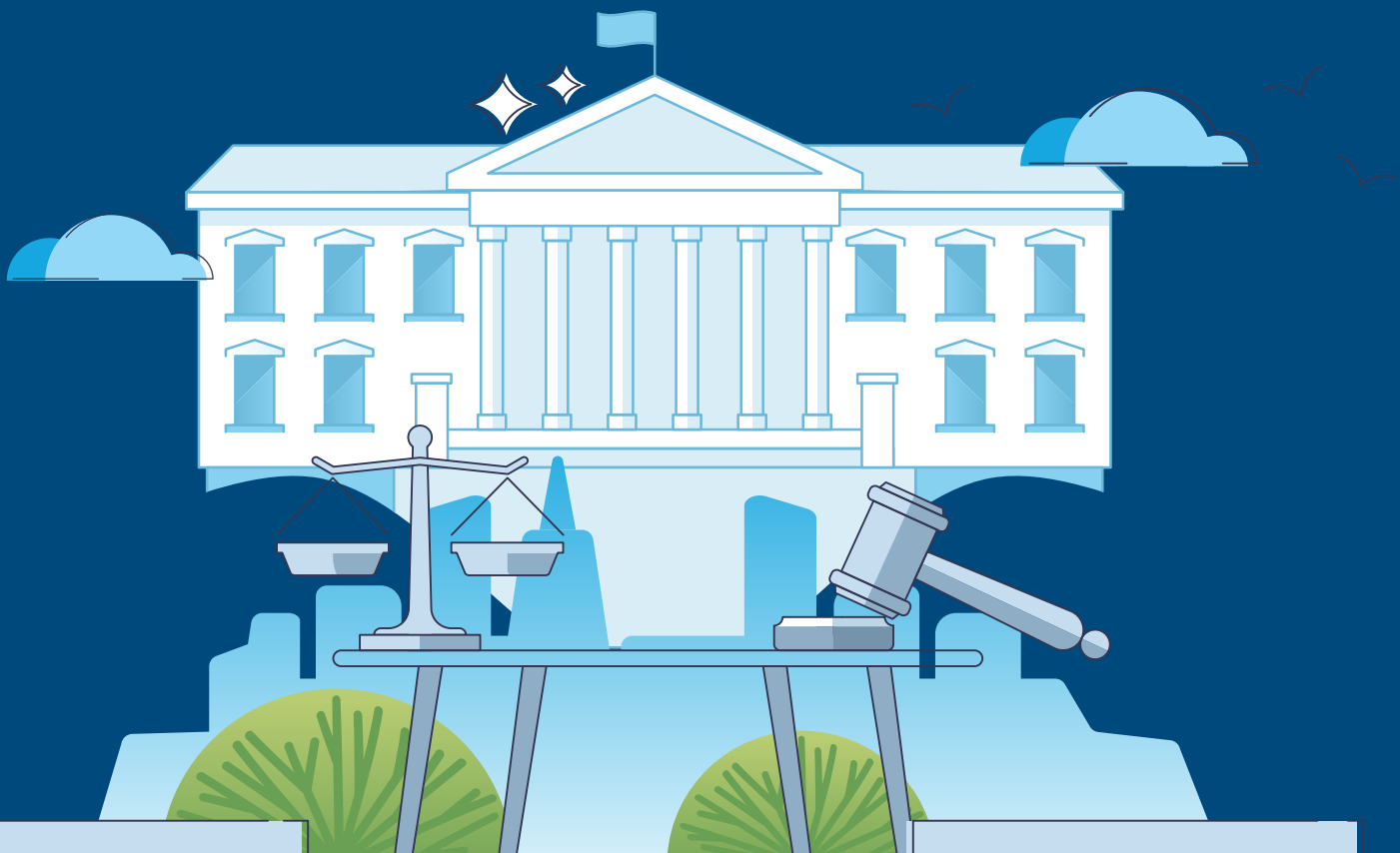
Together, strong internal governance, combined with workforce, infrastructure, technology and asset-level interventions, can achieve scale and durability only when aligned with the broader policy and ecosystem landscape. This alignment ensures that internal governance aligns with the broader policy framework required for long-term heat resilience. Thus, moving from short-term fixes to portfolio roadmaps requires close coordination with public policy, regulatory codes and government planning. The Indian government has established guidelines, codes and policies across each level to address heat. At the national level, MoEFCC introduced the India Cooling Action Plan in 2019, targeting a 25 to 40 percent reduction in cooling energy requirements by 2037–38. MoEFCC also launched the National Clean Air Programme in 2019 to cover 131⁴⁶ cities with an aim of achieving 40 percent PM₁₀ reduction by 2025–26. Building codes, such as the ECBSC and ENS,⁴⁷ focus on achieving energy efficiency and sustainability for commercial and residential buildings. States publish independent Heat Action Plans (HAPs) and targeted policies aligned with NDMA/IMD guidance, such as Telangana's Cool Roof Policy,⁴⁸ launched in 2023, which targets 300 km² of cool roofs across the state by 2028. Cities implement heat governance through municipal HAPs, such as Ahmedabad, which drafted the first city HAP in 2013⁴⁹ to encode early warning systems and safety measures in the city guidelines, which resulted in 2,380⁵⁰ deaths being avoided post-implementation of the HAP. While these plans and initiatives focus on solutions such as cool roofing, blue infrastructure, urban forestry and warning systems, progress across the

country remains uneven, calling for a stronger push for faster adoption, consistent implementation and enforceability across states and municipalities.

The path forward requires coordinated action across all stakeholders. Companies should embed heat governance within their EHS and ESG frameworks, align site-level actions with IMD alerts and schedule intensive physical labour during cooler hours. Governments must ensure that rules and funding are clear and consistent through robust Heat Action Plans, building codes and targeted investments in green and blue urban assets. Civil society plays a vital role in delivering last-mile support, ensuring that water points and cool roofs reach the most heat-exposed neighbourhoods.

Ultimately, building heat resilience in India is a phased journey. It starts with quick wins, such as rescheduling shifts and partial cool roof coverage, progresses through medium-term upgrades, including permeable pavements and smart controls and culminates in long-term investments, including deep energy retrofits and expanded urban canopies.

With much of the urban infrastructure of 2050 yet to be built, the choices made today will shape local climates for decades to come. By acting now, India has an opportunity to protect its workers, sustain business performance and ensure its urban and industrial zones remain livable and cool for the future.



List of abbreviations

S. No.	Abbreviation	Description
1	AC	Air Conditioning
2	ATES	Aquifer Thermal Energy Storage
3	CaaS	Cooling-as-a-Service
4	CAPEX	Capital Expenditure
5	CO ₂	Carbon dioxide
6	ECBC	Energy Conservation Building Code
7	ECBSC	Energy Conservation & Sustainable Building Code
8	EHS	Environment, Health & Safety
9	ENS	Eco Niwas Samhita
10	ESG	Environmental, Social & Governance
11	FSSAI	Food Safety and Standards Authority of India
12	Gt	Gigatonne
13	GW	Gigawatt
14	HAP	Heat Action Plan
15	HVAC	Heating, Ventilation and Air Conditioning
16	ILO	International Labour Organisation
17	IMD	India Meteorological Department
18	M	Million
19	MoEFCC	Ministry of Environment, Forest & Climate Change
20	NDMA	National Disaster Management Authority
21	O&M	Operations & Maintenance
22	OPEX	Operating Expenditure
23	PM ₁₀	Particulate matter with aerodynamic diameter ≤ 10 micrometres
24	SOP	Standard Operating Procedure
25	SRI	Solar Reflectance Index
26	UHI	Urban Heat Island
27	WBGT	Wet-Bulb Globe Temperature

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