

EXTREME **HEAT** RISK GOVERNANCE

FRAMEWORK AND TOOLKIT



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Foreword



Extreme heat has emerged as one of the most pressing climate-related threats to lives, livelihoods, and the ecosystems and infrastructure that sustain the well-being of societies. The science is clear: chronic heat and heatwaves are increasing in frequency, intensity and duration, with effects felt in every region. Yet heat remains a risk that is often underestimated in its severity and complexity, and therefore insufficiently understood and governed. As a result, too many avoidable illnesses, deaths and disruptions continue to impact people, nature and economies.

The growing demand from Member States and partners for clear guidance and practical tools reflects the urgency of strengthening capacities to better prevent, reduce, anticipate and manage this threat. The United Nations Secretary-General identified extreme heat as a global priority in 2024 and has called for urgent and coordinated action to protect the most vulnerable, safeguard workers, strengthen resilience through science and data, and limit global warming to 1.5 °C. Experience shows that when institutions work together, and authorities are empowered to act, lives and livelihoods are protected and made more resilient.

Heat risk reduction relies on effective cross-sectoral and multi-level coordination and governance. It requires institutions that plan together long before a heatwave strikes, take preventative and mitigating measures in advance, prepare for and respond together during emergencies, and learn collectively to improve over time. It calls for clarity on roles and responsibilities, integration across sectors and domains – including health, meteorology, risk management, planning, energy and labour systems – and a dedicated focus on those people, systems and ecosystems facing the highest risks. Good risk governance can turn risk information into equitable, just, and resilient action.

This Extreme Heat Risk Governance Framework and Toolkit is our contribution to meeting those requests from countries. Developed through a truly collaborative process that has engaged experts from governments, bi- and multi-lateral partners, financiers and civil society across regions, it provides practical guidance to strengthen decision-making and coordination on extreme heat. It offers tools for assessing governance maturity, enhancing heat action planning, and supporting cross-sectoral implementation. It is designed to be adaptable, recognising that each country and city brings its own context, strengths and challenges. Importantly, this is the first edition of an evolving resource. It will be tested and refined in practice, with feedback from early adopters informing future improvements. This process of learning and continuous enhancement is central to effective climate action.

The cost of inaction is high and untenable. Yet solutions are within reach. By working together, guided by meaningful collaboration, robust evidence and a shared purpose, we can safeguard the most vulnerable, reduce the human, economic and ecological impacts of heat, and build resilience at every level of society. We invite leaders and practitioners everywhere to put this Framework and Toolkit to use, and to join a growing global movement working toward a world where extreme heat is no longer a barrier to lives and livelihoods.

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Executive Summary

Extreme heat risk arises when sustained high temperatures exceed levels that people, natural and built environments can safely tolerate. As climate change accelerates, global temperatures continue to rise, creating conditions of greater exposure and vulnerability. Extreme heat risk has now reached levels that threaten health, well-being and the functioning of societies, demanding urgent and cross-sectoral coordinated action.

Extreme heat events have become more frequent, more intense and longer lasting, leading to widespread societal and ecological impacts. This has prompted the United Nations Secretary-General to identify extreme heat as a priority climate challenge, calling for urgent, coordinated action to enhance prevention, preparedness, resilience and governance. Without decisive intervention, rising global temperatures will continue to drive increases in heat-related mortality and morbidity, reduce productivity, disrupt infrastructure and ecosystem services, and exacerbate existing inequalities, particularly in regions with limited adaptive capacity.¹

Successfully managing extreme heat risk requires effective, integrated planning and action by governments and a wide range of other stakeholders from multiple sectors, systems, domains, scales and geographies across all temporal frames. Today, there are multiple challenges that need to be addressed to ensure that these systems work together to minimize extreme heat risks. Some of these challenges include:

Fragmented, uncoordinated policies, and lack of enabling legislative or regulatory support

- Reactive, short-term management approaches
- Lack of clear roles and responsibilities
- Data gaps and lack of information integration and a clear and common taxonomy
- Limited and disconnected financial mechanisms
- Inequitable impact on vulnerable populations

Fundamentally, these are all governance challenges, which limit action at the pace and on the scale required to avoid extreme heat risk overwhelming us.

¹ [United Nations Secretary-General's Call to Action on Extreme Heat](#) (United Nations, 2024).

We define extreme heat risk governance as a coordinated and inclusive process through which actors (e.g. government officials, communities, business owners, workers, investors and funders, civil society, international organizations, etc.), institutions (e.g. ministries, utilities, the health sector, worker coalitions, etc.), and assets (e.g. data systems, cooling centres, urban planning tools, critical infrastructure, basic services, etc.) work together across multiple timescales to guide, coordinate, implement and oversee the reduction of heat-related risks and related areas of policy, investment and action.² These timescales span short-term emergency response and early warning systems, medium-term seasonal mitigation and preparedness, and long-term risk prevention, reduction and resilience.

Effective extreme heat risk governance is guided by a set of core principles: being people- and ecosystem-centred, equitable, inclusive, agile, collaborative, proactive, whole-system and informed by evidence.

This toolkit is designed to support decision makers to measure, understand, strengthen and sustain extreme heat risk governance. As a tool supporting integrated approaches, it is intended to be applicable at different scales and in and among multiple sectors. While the preliminary focus has been at the national level, the toolkit has been designed to be applied and further developed at other geographic scales and in other jurisdictions. Rather than prescribing a one-size-fits-all solution, the toolkit provides a flexible framework and set of tools that governments and partners can adapt to their own contexts.

The toolkit includes three core tools that decision makers can apply directly:

Tool 1: Assess the Maturity of your Extreme Heat Risk Governance enables decision makers to systematically evaluate the current state of their extreme heat risk governance systems across five key dimensions: recognition, leadership, response, resources and collaboration. Completing this activity can help identify strengths, gaps and priority areas for improvement, define targeted actions and guide next steps.

Tool 2: Operationalize Extreme Heat Risk Governance guides decision makers in fostering cross-sectoral coordination, information-sharing and institutional capacity to strengthen heat risk governance through an iterative cycle built around four components: Demand, Plan, Act and Learn & Improve. This cycle begins with a demand for action (or “agenda setting”), often triggered by problem identification, crisis, leadership or public pressure, which must be translated into a concrete mandate. From there, inclusive and coordinated planning processes set goals, assign responsibilities, foster ownership and prepare for implementation. The action component delivers tangible interventions, ranging from emergency response to long-term heat risk mitigation and prevention investments, supported by systems that allow agile and data-informed decision-making. Finally, structured learning processes ensure that successes and failures are assessed, shared and used to improve future efforts.

At the core of each stage is the effective use of research, data and analytics with the mechanisms to guide decision makers and evaluate impact. This governance approach is designed to work across different contexts – from local to global, and low- to high-resource – and helps ensure that extreme heat responses are timely, equitable and sustainable over the long term.

Tool 3: Plan for Heat Action guides decision makers in identifying the core components of effective Heat Action Plans (HAPs), alongside good practices and strategies for building long-term, cross-sectoral heat resilience. HAPs can serve as powerful organizing mechanisms that bring together different sectors and timescales of activities under a unified approach to extreme heat risk governance. While it is not the only pathway to progress, the toolkit includes a dedicated module outlining the essential elements that should be taken into account for building or strengthening effective HAPs.

² [Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction](#), United Nations General Assembly (A/71/644).

To further ground these three tools in real-world experience, the framework and toolkit also features an Appendix with a series of resources to learn from others, including lessons learned from 13 case studies and external resources. These resources highlight practical lessons, innovative approaches and the common challenges encountered in extreme heat risk governance, providing inspiration and guidance for prevention and adaptation in other contexts.

The development of this framework and toolkit represents a truly collaborative effort. It was shaped through the generous contributions of a diverse group of experts, academics and practitioners from governments, bi- and multi-lateral and other international organizations and civil society, working across disciplines and regions. Many participated at an in-person [consultation workshop](#), virtual meetings, and also through thoughtful feedback and detailed reviews to strengthen the accuracy, clarity and practical value of this work. Their collective insights, rooted in science, policy and practice, were instrumental in ensuring that the Frameworks reflects real-world needs to the greatest extent possible.

This document is the first edition of an evolving framework and toolkit. It will be piloted and tested in different countries and contexts, and at different scales, to assess its applicability, usability and relevance. Insights and feedback gleaned from these and other exercises will guide subsequent updates, ensuring that future iterations are refined through real-world experience.

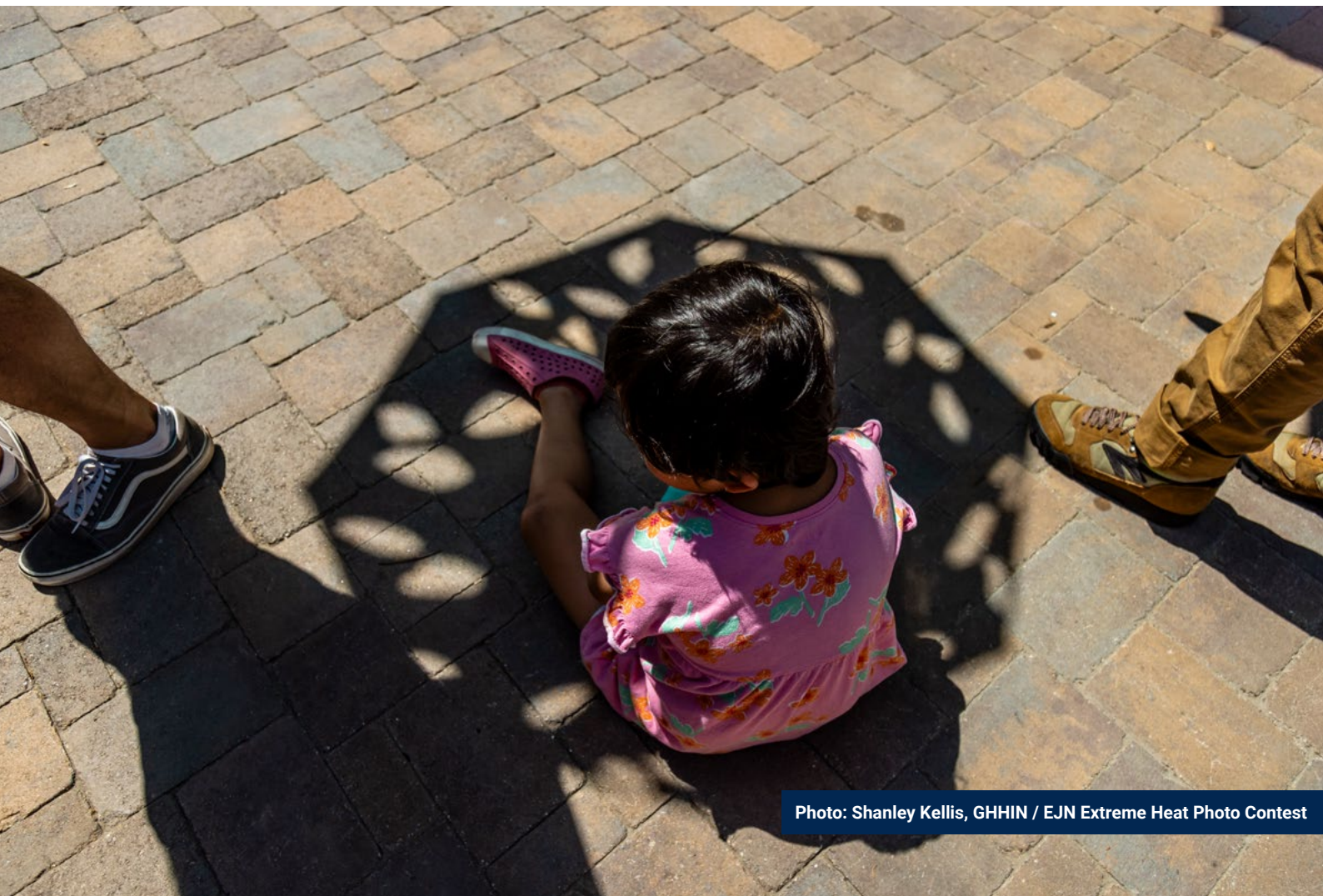


Photo: Shanley Kellis, GHHIN / EJN Extreme Heat Photo Contest

The extreme heat risk governance challenge

As extreme heat events grow in frequency, intensity and duration, they present a complex and cross-cutting challenge to national, subnational and municipal administrations. Extreme heat negatively affects the health and well-being of humans and ecosystems. It impacts the functioning and viability of critical infrastructure (power generation and supply, health and education service delivery, transport systems, communications, etc.), the world of work and productivity, agriculture and food systems, the environment, livelihoods and social protection sectors, requiring a coordinated cross-sectoral and adaptive response. Impacts can often be simultaneous, continuous and cascade through sectors, scales and time.

Jurisdictions have begun to address this through early warning systems, multi-temporal planning and Heat Action Plans (HAPs). However, these efforts are frequently developed within individual sectors or time frames, making it harder to align actions and scale solutions.

To move toward more coordinated and resilient systems, it is essential to first understand the persistent obstacles that have limited the effectiveness and reach of extreme heat risk governance to date. Following several expert consultations and dialogues around the world with Member States, six (non-exhaustive) interrelated challenges have emerged as being particularly critical to address:

I. Fragmented and uncoordinated policies

Extreme heat touches nearly every facet of a society – from health systems and housing to energy infrastructure, labour regulations and agriculture – yet governance mechanisms are rarely designed to reflect this reality. Ministries and agencies tend to operate in sectoral (and sometimes scalar) silos, each developing policies, investments and programming in isolation. Incentives for cross-sectoral efforts are usually lacking. The absence of multilevel coordination – between sectors and between local and national governments – can hinder effectiveness, economies of scale and access to funding, and limit knowledge and information sharing, thereby delaying the creation of enabling conditions for effective action for heat resilience. This fragmentation leads to duplicated efforts, missed synergies and inefficiencies in heat risk reduction and management.³ For instance, a city may develop a cooling centre initiative without coordination with the health authority or electricity providers, limiting impact and sustainability.

II. Reactive, short-term crisis management

The prevailing approach to extreme heat is reactive, focusing on crisis response rather than risk prevention

³ Heat risk management is the application of heat risk reduction policies and strategies to prevent new heat risk, reduce existing heat risk and manage residual risk, contributing to the strengthening of resilience and reduction of losses and damage from extreme heat and chronic heat. (A/71/644 United Nations, 2016)

or mitigation. Most interventions are activated during or just prior to heatwaves, often under emergency mandates. While life-saving, these measures do not prevent nor reduce heat risk, nor do they build adaptive capacity and thus long-term resilience, as they fail to address chronic exposure, vulnerability or the systemic root causes of heat risk. Effective governance requires moving from a 'crisis response mindset' towards an institutionalized, prevention-oriented approach – for example, embedding heat risk reduction into urban planning and design, environmental regulations and labour protections. This, in effect, means addressing heat risk before it manifests as a heat shock or a disaster. Without this shift, heat action will remain largely crisis-driven rather than preventative, precautionary or anticipatory and the resulting suffering, losses and damages, and costs will be larger than they need to be. This is simply unsustainable, driving increasing exposure and vulnerability with corollary impacts that threaten to overwhelm us.

III. Lack of clear roles and responsibilities

Ambiguity over who is accountable for heat risk governance is a major barrier to effective planning and action. In most countries, there is no single agency or coordinating body responsible for aligning cross-sectoral, multi-scale heat strategies that encompass prevention, mitigation, adaptation, response and thus resilience. This leads to fragmented mandates, unclear leadership, inertia and confusion. Establishing and building capacity and competence within formal governance mechanisms that define and distribute responsibilities – across, for example, health, energy, planning and disaster risk agencies – are essential for coherent and sustained planning and action.

IV. Data gaps and lack of data integration

Reliable, integrated data is foundational to effective heat risk governance, yet many decision makers lack standardized metrics, data-sharing agreements or centralized systems for real-time decision-making. Where data exists, critical data sets on temperature thresholds, vulnerability mapping, health outcomes and urban exposure are often held by separate institutions and not interoperable. This impedes multiple actions, including prevention, adaptive planning, early warning systems and public advisories. Developing interoperable platforms and protocols for sharing climate-health data must be a top priority for national and local actors.

V. Inequitable impact on vulnerable populations

Extreme heat does not affect all localities or populations equally. For example, older adults, workers, displaced or marginalized persons, pregnant women, children, people with pre-existing medical and mental health conditions, and low-income households, among others, face disproportionate exposure and fewer resources to help them adapt. Yet many governance systems fail to incorporate the lived realities and specific needs of these groups into planning and response. Heat action plans often lack localized vulnerability assessments or targeted protections such as worker safety regulations, cooling subsidies or accessible public spaces. Equity should be embedded into all phases of governance, from early warning to long-term resilience⁴ planning.

VI. Limited financial mechanisms and investment

Despite increasing recognition of extreme heat as a critical risk, there remains both a significant funding gap and critical disconnects in the design and deployment of finance streams for integrated heat risk prevention, mitigation and adaptation. Few jurisdictions have developed specific business cases to justify dedicated budgets or financial instruments specifically for heat resilience, let alone heat risk-sensitive sectoral investments. Investments in adaptive infrastructure such as green roofs, early warning systems or passive cooling retrofits are often ad hoc and underfunded. Furthermore, current climate finance mechanisms may not prioritize heat, leaving local governments without the resources to act. Technical tools must be developed, used and applied to make the actions needed to address extreme heat investible. These may include, for example, heat risk analytics and risk management frameworks, economic and financial valuation tools, policy and regulatory enablers (including financial regulations) and advanced market commitments. Without such measures, the ability to shape and deploy public and private capital, and mainstream sustained financial support across all governance levels, will mean actions to address extreme heat will be randomly and insufficiently funded or financed, even in the presence of external financial mechanisms.

⁴ The ability of a system, community or society exposed to [extreme heat] to resist, absorb, accommodate, adapt to, transform and recover from [its] effects in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through [heat] risk management. (United Nations General Assembly, 2016. A/71/644)

To shift from isolated interventions to resilient systems, countries must navigate a strategic transformation in how extreme heat risk is governed. Figure 1 captures the directional change needed across the six extreme heat risk governance challenges described above:

Figure 1: Extreme heat risk governance aims



Understanding extreme heat

The recent WMO State of the Global Climate report confirmed that 2024 was the hottest year the planet ever recorded,⁵ with each of the past 10 years (2015–2024) among the hottest. Rising global temperatures are leading to more frequent, severe and prolonged hot weather conditions, which worldwide result in serious localized stress and threats for human well-being and socioeconomic growth and development. When temperature conditions start to exceed the upper natural thermal limits where people, plants, and materials comfortably thrive and function, we begin to move from “hot conditions” to ambient “heat hazards”. This chapter briefly lays out the phenomenon of heat as a meteorological hazard and how heat conditions and risk are quantified and described, followed by sections that describe the primary drivers of vulnerability and impacts of heat risk, namely (1) climate and meteorological drivers, (2) social and biological drivers and (3) environmental drivers, followed by a final section on the vulnerability of socioeconomic systems to heat.

What is heat?

Temperature and heat conditions are often described and measured in relation to the location (e.g. indoor, ambient, marine or urban) and timing of their occurrence (e.g. episodic, seasonal, or persistent in nature). Temperature and heat are related but not the same. Temperature is a measure of how hot or cold something is and is described in degrees Celsius (°C), Kelvin (K) or Fahrenheit (°F). Heat, however, refers to the transfer of energy between objects (e.g. between hot air and the body, a surface or a material) because of a difference in temperature, in other words, “heating up” or “cooling down”. Heat is thus commonly described through either environmental or human heat-balance models using complex indices. The terms “extreme” or “high” are often applied to explain the magnitude of difference in relation to background average conditions for a location or time of year. Table 1 outlines common terms used to describe diverse manifestations of heat.

5 WMO, [State of the Global Climate 2024](#) (Geneva, 2025).

Table 1: Common terms used to describe diverse manifestations of heat

Acute/Episodic Heat	Seasonal	Persistent heat
Heatwave Heat dome Heat event/episode Temperature extreme or anomaly High heat High temperatures Thermal extremes Warm spells	Heat season	Chronic heat Tropical nights
Common measures of heat conditions		Place-based references
Intensity Magnitude Duration Severity Geographic extent Onset Excess		Indoor heat Outdoor heat Urban heat Tropical heat Arid/Dry heat Marine heat/heatwave Occupational heat (both ambient and metabolic) Waste heat (human-caused)

In terms of time, extreme heat has become more frequent, intense and longer lasting across all regions due to a changing climate, with broad impacts spanning human health and productivity, agricultural systems, technology and the built environment, and disrupting basic services such as water and energy. Both short-term extreme heat events (such as heatwaves) and longer-term exposure to persistent high temperatures pose serious risks. While heatwaves often attract public attention, continuous heat exposure – especially when combined with high humidity – can be equally dangerous and disruptive. Many heat-related illnesses and deaths occur outside officially declared heatwave periods, highlighting the need to understand how both acute and chronic heat exposure contribute to health, education and other risks.

In geographical terms, heat is a localized phenomenon that affects both rural and urban areas. However, cities and peri-urban areas experience a localized amplification of heat conditions, known as “urban heat”. This results primarily, but not exclusively, from three factors: (1) the concentration of materials such as concrete, steel and asphalt that absorb heat during the day and re-emit heat overnight; (2) urban expansion is often coupled with an increase in impermeable surfaces and loss of trees or green vegetative areas, reducing vegetative surfaces and water (i.e. green and blue cover) and natural evapotranspiration that cools the environment; and (3), additional “waste heat” is generated by combustion engines in transport, energy and industrial systems, further warming the local environment. This combination results in urban areas being several degrees warmer than surrounding rural areas, which is described as the “urban heat island” effect.

Further information about multi-hazard and multisectoral dimensions is provided in section 2.2.2 on drivers of vulnerability.

2.1 Quantification of heat conditions and risk

What qualifies as “extreme”, “excess” or “dangerous” heat must be defined relative to the context, including the climatic and other meteorological conditions of a given location. Thus, there is no single universal definition or temperature threshold for “extreme heat”. To define what levels of heat are dangerous or extreme in a particular location, definitions often rely on statistical thresholds, such as the 90th or 95th percentile of historical average temperatures for a given region or the duration of the heat. Other definitions may use an intensity measure or account for factors such as humidity, wind speed and solar radiation, which influence perceived (or “felt like”) temperature and the physiological effects on humans. These approaches are all complementary measures that provide different types of information. Additionally, humans generate internal metabolic heat through physical activity, which increases overall heat load in the body and lowers the threshold for risk from extreme ambient temperatures.

The WMO Handbook on Extreme Heat Indicators and Indices (forthcoming) emphasizes the need for a standardized yet flexible approach to defining and monitoring extreme heat. It highlights the importance of distinguishing between short-term, high-intensity heat events and cumulative exposure to prolonged heat stress, as both contribute to adverse outcomes. A large range of indicators and indices can be used to measure heat, each serving a distinct purpose for research, weather forecasting or early warning systems, with strengths and weaknesses in their application and representation. Here we describe some common heat indicators, indices and metrics that decision makers are likely to encounter. For a more comprehensive technical perspective, see WMO (forthcoming).⁶



⁶ WMO, Handbook of Extreme-Heat Indicators, Indices and Metrics: A Measurement Guide for Characterising and Monitoring Heatwaves for Impact Services (Geneva, forthcoming).

Box 1: Measures of physical temperature

Measured from one or more variables of air temperature, humidity, wind speed and radiation conditions, and environmental-heat balance models. Commonly used measures include:

Maximum daily temperature⁷

The highest air temperature recorded in a 24-hour period in an outdoor location. Commonly used in extreme temperature warnings and climate trend analysis.

Minimum daily temperature⁸

The lowest air temperature recorded in a 24-hour period in an outdoor location. Often used to assess night-time environmental conditions and the ability of the environment to accumulate or cool down during multi-day heatwave events. Useful for evaluating heat-related mortality and heat stress in vulnerable populations.

Excess Heat Factor (EHF)⁹

A heatwave intensity and severity measure that characterizes heatwave conditions based on short- and long-term temperature anomalies at a given location. EHF is used to identify heatwaves and is widely applied in heatwave warning systems. May not be suited for all climates without regional adjustments.

Wet-bulb temperature (WBT)¹⁰

WBT is a combined measure of temperature, humidity and pressure. It can be measured using a wet-bulb thermometer or wet-bulb temperature probe, whereby the base of the instrument is wrapped in a damp cloth. As water evaporates from the cloth, the temperature of the instrument reduces. This process is similar to the cooling experienced due to sweating. WBT can be calculated using temperature, humidity and pressure measurements when WBT instruments are not available. While this metric considers humidity, it does not consider other stressors such as wind speed and radiation. Natural WBT (a variant of WBT) exposes the instrument used to measure WBT to wind and solar radiation. Natural WBT is used to calculate wet-bulb globe temperature. WBT is not directly comparable to standard temperature measurements and is thus confusing to the general public.

Standardized Heatwave Index (SHI)¹¹

A 3-day standardized temperature anomaly index that compares observed daily maximum and minimum temperatures to climatological norms for a rolling 15-day or 21-day period. Inspired by the Standardized Precipitation Index (SPI). Useful for climate studies and anomaly detection. Not used for real-time warnings, as it over-warns due to picking up warm anomalies at any time of the year.

Heatwave Magnitude Index (HWMi)¹²

A measure of heatwave severity that aggregates intensity and duration over time, ranking heatwaves based on deviation from historical temperature distributions. Applicable for long-term heatwave climate trend analysis.

7 http://etccdi.pacificclimate.org/list_27_indices.shtml

8 http://etccdi.pacificclimate.org/list_27_indices.shtml

9 Ehsan Raei, Mohammed Reza Nikoo, Amir AghaKouchak and others, "GHWR, a multi-method global heatwave and warm-spell record and toolbox", *Sci. Data*, 5, 180206 (2018). DOI: 10.1038/sdata.2018.206.

10 Steven Sherwood and Matthew Huber, "An adaptability limit to climate change due to heat stress", *Proc. Natl. Acad. Sci. U. S. A.*, 107(21), 9552–9555 (2010). DOI: 10.1073/pnas.0913352107; Roland Stull, "Wet-bulb temperature from relative humidity and air temperature" *J. Appl. Meteorol. Climatol.*, 50(11), 2267–2269 (2011). DOI: 10.1175/JAMC-D-11-0143.1.; Jennifer Vanos, Gisel Guzman-Echavarria, Jane W. Baldwin and others, "A physiological approach for assessing human survivability and liveability to heat in a changing climate", *Nature Communications*, 14(1), 7653 (2023). DOI: 10.1038/s41467-023-43121-5.

11 Ehsan Raei and others, "GHWR, a multi-method global heatwave and warm-spell record and toolbox" (see footnote 9).

12 Alessandro Dosio, Lorenzo Mentaschi, Erich M Fischer and Klaus Wyser, "Extreme heat waves under 1.5 °C and 2 °C global warming", *Environ. Res. Lett.*, 13, 054006 (2018). DOI: 10.1088/1748-9326/aab827; Chloé Prodhomme, Stefano Materia, Constantin Ardilouze and others, "Seasonal prediction of European summer heatwaves", *Clim. Dyn.*, 58, 2149–2166 (2022). DOI: 10.1007/s00382-021-05828-3.

Box 2: Measures of heat stress

Calculated based on human physiological heat balance models, perception and comfort models. Common indicators include:

Apparent Temperature (AT)¹³

A rational index that describes the combined effect of air temperature, humidity and wind speed on human thermal comfort, optionally incorporating radiation effects. More comprehensive than Heat Index (HI) but not commonly used in operational warning systems. AT is often referred to as the “feels like” temperature. For temperatures below the mid to high 30 °Cs, wind will create a wind-chill effect; at higher temperatures, wind in dry conditions will have a heating effect. Caution is required in using AT formulations that are appropriate for current temperature, humidity and wind conditions.

Heat Index (HI)¹⁴

A simplified empirical index that samples ranges of Apparent Temperature and is derived from basic meteorological parameters, which provides a straightforward way to assess perceived temperature or thermal discomfort. HI is a function of temperature and relative humidity and does not include wind or radiation effects. Common in public health advisories but lacks direct solar radiation and wind cooling effects, limiting accuracy in shaded versus unshaded areas.

Physiological Equivalent Temperature (PET)¹⁵

A human biometeorological index based on a simplified energy-balance model that estimates thermal comfort based on temperature, wind speed, humidity and radiation exposure. Commonly used in urban climate studies and public health planning but requires assumptions about clothing and activity levels that may not reflect real-world variability.

Universal Thermal Climate Index (UTCI)¹⁶

An equivalent temperature based on an energy-balance model for humans, designed to assess the thermal perception of people staying outdoors. UTCI incorporates temperature, humidity, wind speed and radiation. More comprehensive than HI, suitable for outdoor applications, but requires detailed input parameters not available in real-time settings.

Wet-bulb Globe Temperature (WBGT)¹⁷

A measure of biological heat stress, incorporating temperature, humidity, wind speed and solar radiation, which provides an estimate of probable heat stress. WBGT can be measured through specialized instruments, but is most commonly derived from routine meteorological observations. It is a weighted average of air temperature, natural wet-bulb temperature and black globe temperature. Wet-bulb temperatures are useful for research but have a lower range than standard temperature measures, which can be confusing for the public.

13 Kryszttof Błażejczyk, Yoram Epstein, Gerx Jendritzky and others, “[Comparison of UTCI to selected thermal indices](#)”, Int. J. Biometeorol., 56(3), 515–35 (2011). DOI: 10.1007/s00484-011-0453-2; PMID: 21614619; PMCID: PMC3337419.

14 Lans P. Rothfusz (1990). [The Heat Index “Equation” \(or, more than you ever wanted to know about Heat Index\)](#). NWS Southern Region Technical Attachment 990, SR/SSD 90-23; Fort Worth, TX, USA; p. 2. https://www.weather.gov/media/bgm/ta_htindx.PDF (accessed on 17 April 2010). 21.; R.G. Steadman, “[The Assessment of Sultriness. Part II: Effects of Wind, Extra Radiation and Barometric Pressure on Apparent Temperature](#)”, J. Appl. Meteorol., 18, 874–885. DOI: [10.1175/1520-0450\(1979\)018<0874:TAOSPI>2.0.CO;2](#)

15 Yung-Chang Chen and Andreas, Matzarakis, “[Modified physiologically equivalent temperature – basics and applications for western European climate](#)”, Theor. Appl. Climatol., 132, 1275–1289 (2018). DOI: 10.1007/s00704-017-2158-x.; P. Höppe, “[The physiological equivalent temperature - a universal index for the biometeorological assessment of the thermal environment](#)”, Int. J. Biometeorol., 43, 71–75 (1999). DOI: 10.1007/s004840050118.

16 Peter Bröde, Dusan Fiala, Kryszttof Błażejczyk and others, “[Deriving the operational procedure for the Universal Thermal Climate Index \(UTCI\)](#)”, Int. J. Biometeorol., 56, 481–494 (2011). DOI: 10.1007/s00484-011-0454-1.

17 Grahame M. Budd, “[Wet-bulb globe temperature \(WBGT\)—its history and its limitations](#)”, J. Sci. Med. Sport, 11, 20–32. DOI: 10.1016/j.jsams.2007.07.003; Francesca R. d'Ambrosio Alfano, Jacques Malchaire, Boris Igor Palella and Giuseppe Riccio, “[WBGT Index Revisited After 60 Years of Use](#)”, Ann. Occup. Hyg., 58, 955–970 (2014). DOI: 10.1093/annhyg/meu050; C.P. Yaglou and D. Minard, “[Control of heat casualties at military training centers](#)”, AMA Arch. Indust. Health, 16(4), 302–316 (1957). PMID: 13457450.

2.2. Drivers and impacts of extreme heat risk

This section provides a brief overview of extreme heat risk, its root causes and its impacts. It is not intended to be exhaustive – for more detailed information, see the additional resources in the Appendix.

2.2.1. Climatic / meteorological drivers of heat conditions

Human-caused climate change is the dominant driver of the observed increases in the intensity, frequency and duration of warm extremes on a global scale. By increasing global average temperatures, temperature variability has increased, and atmospheric circulation patterns have been altered. The result is that a greater number of people, in larger geographic areas, are exposed to higher temperatures, for longer periods of time.

Extreme heat events are driven by a combination of atmospheric and environmental factors. Persistent large-scale blocking high-pressure circulation patterns limit cloud formation, and dry and trap heat in the air mass, particularly near the surface of the earth, which leads to prolonged heat events. Oceanic currents also influence global heat distribution in both the oceans and atmosphere, resulting in extreme heat conditions being more likely to occur during specific seasons and climate phases. The local built environment and landscape (e.g. coastal or elevation) also modify synoptic weather patterns and can amplify regional heat patterns, creating different exposure levels across communities within a region.

The meteorological drivers of heat vary significantly across latitudes due to differences in solar energy radiation, atmospheric circulation and surface conditions. In low latitudes (e.g. tropical and subtropical regions), intense year-round solar radiation and high humidity create persistently hot conditions that limit natural cooling and are increasingly also experiencing episodic extreme temperatures. In mid-latitudes (e.g. temperate climate zones), seasonal solar peaks, persistent high-pressure systems and land–atmosphere feedback amplify seasonal summer heat conditions and witness pronounced acute heat events. At high latitudes (arctic/sub-arctic), warming is accelerated by melting ice and snow, reduced surface reflectivity and the northward movement of warm air masses. Together, these processes shape the uneven distribution and growing intensity of heat across the globe.

2.2.2. Social and biological drivers of heat vulnerability and impacts

Every human exposed to extreme heat can be at risk for heat injury and illness. However, socioeconomic status, location, gender, age, occupation and health status significantly influence who is most negatively affected. Social vulnerability is not static, as individuals and groups may move in and out of risk depending on social and economic circumstances.

Biological, gender and health risk factors: Heat stress disproportionately affects older adults (over 60 years of age), heat-exposed workers, displaced and low-income communities and individuals with pre-existing physical or mental health conditions. This includes individuals with comorbidities including obesity, diabetes, hypertension, heart disease, renal disease, dementia and alcoholism, who for physiological or behavioural reasons are unable to release heat from their bodies in hot conditions. Infants are especially vulnerable because their bodies and temperature regulation systems are still developing, and they depend completely on their caregivers for care and survival.

Gender dynamics can amplify this and intersect with other vulnerabilities. Pregnant women have higher internal heat and shifting metabolic and hormone balances. Exposure to heat results in a statistically higher risk of hospitalization, especially during the third trimester. Women, including pregnant women, older adult women and women involved in informal caregiving and agriculture often face greater heat exposure and barriers to accessing protective information and services.

2.2.2.1. Social drivers of heat vulnerability and impacts

Key social drivers of vulnerability to heat include:

Poverty, informality and access to critical services: Critically, levels of access to essential services including energy, water, civil protection and healthcare services strongly determine individual and community capacity to cope with heat. For example, housing quality, access to cooling infrastructure and the presence of green spaces all influence an individual's ability to cope with extreme heat. Poorly insulated buildings, overcrowded housing, confined spaces, inadequate electricity supply and the absence of effective cooling systems disproportionately expose low-income communities to higher temperatures. Energy poverty heightens heat risk, as the exposure of households unable to afford or access electricity and cooling systems is compounded.

People living in informal settlements or with poor housing conditions face even higher exposure and risk, often due to inappropriate building materials, inadequate and insufficiently insulated housing, a lack of access to effective cooling systems and fewer green spaces or public cooling centres. These issues can also arise if energy prices or financial hardship prevent individuals from using cooling systems. Lack of access to healthcare or a failure of healthcare service delivery can further exacerbate impacts. These patterns illustrate that while heat is a universal hazard, its impacts are shaped by geography, inequality, gender and local contexts.

Migration and population displacement: Displaced individuals are often among the most exposed and least equipped to manage extreme heat. Many live or work in precarious settings – such as informal settlements, temporary shelters or outdoor environments – with limited access to cooling, clean water and healthcare. Displacement sites are frequently located in areas with poor infrastructure and high exposure to heat, compounding risks of dehydration, heat-related illness and disruptions to livelihoods. Undocumented or irregular migrants may also avoid seeking medical help, entering cooling centres or seeking public assistance due to fear of deportation or discrimination, further increasing vulnerability.

Labour: Heat-exposed workers, such as those in construction, agriculture, factories and transportation face prolonged exposure to high temperatures, leading to increased risks of death, ill health and traumatic injury, and productivity loss. Economic impacts, particularly among informal and daily-wage workers can drive cycles of vulnerability, where loss of income constrains the ability to invest in extreme heat protection or recovery.

Limited public awareness, heat literacy and preparedness: Communities with limited education on heat dangers and inadequate public health messaging face heightened risks.

2.2.2.2. Environmental and biological drivers of heat vulnerability and impacts

High and prolonged temperatures exert multifaceted stress on flora, fauna and environmental systems by exceeding optimal temperature ranges for growth and reproduction, disrupting thermal balance, hydrological processes and ecosystem functioning, and triggering compounding and cascading extreme weather- and climate-related events.

Elevated temperatures accelerate evapotranspiration, deplete soil and leaf moisture, and reduce surface water availability, leading to ecosystem degradation and biodiversity loss. Fish, wildlife and domesticated animals experience thermoregulatory stress, impacting their health, reproduction and dehydration, and altering feeding, migration and breeding patterns as habitats become less viable or reliable, either suddenly or over time. Vegetation suffers from heat-induced reductions in photosynthetic efficiency, impaired reproductive success and increased susceptibility to pests and disease. When heat results in destroyed biomass (crops and forest loss), reducing albedo and canopy cover and mobilizing pollutants in air and water, ecosystem resilience to additional climatic extremes is further diminished.

High temperatures contribute to and compound the impacts of other hazardous conditions, amplifying the potential for wildfire, localized sea-level rise, drought, storms, deteriorating air quality and water scarcity. The combination of these hazards with high temperatures will intensify the collective damage.

Vulnerability of socioeconomic systems to heat

Rising night-time temperatures, longer heat seasons, high humidity and reduced opportunities for heat offload and physiological recovery exacerbate heat-related health risks. Excessive prolonged heat also reduces labour productivity and learning outcomes, and provokes surging demand for water and energy resources. Over time, these cumulative stresses can weaken economic and social systems, particularly in locations where infrastructure, health and services are already stretched.

Extreme heat risks can be made worse by existing problems in society and the economy. These include ongoing economic instability, poor policy or investment decisions that ignore future climate risk, social unrest and continued dependence on fossil fuels. Root causes and amplifiers of heat impacts can also include weak infrastructure, unequal access to essential services and problems such as power failures or water shortages.

Communities, ecosystems and economies can be impacted severely by rising temperatures, particularly in settings with under-resourced energy systems and water resource management. Inadequate electricity supply or high costs reduce access to cooling options such as fans, air conditioning, heat pumps and refrigeration for essential medicines. Fragilities in energy and power generation and distribution systems exposed to extreme heat can aggravate vulnerability and impact. Infrastructure and energy systems experience significant strain as increased demand for cooling overloads power grids, leading to blackouts. Insufficient water infrastructure, intermittent supply and injudicious use of available water resources can exacerbate heat risk and prevent adequate hydration, impact agriculture and ecosystem services, as well as limiting public cooling measures.

Poor urban planning and design increase extreme heat risk. Heat-absorbing materials (such as concrete, asphalt and metal roofing), a lack of trees and green spaces, and high-density development with poor ventilation all trap heat, exposing residents to sustained high temperatures with limited cooling options. Transport and rail infrastructure networks suffer disruptions as roads warp, rail tracks buckle and flight operations are affected by overheated runways. Buildings and bridges constructed during the twentieth century without heat-resistant materials may deteriorate faster under persistent extreme heat conditions. Such conditions provoke corollary cascading impacts, for example on cold and supply chains that are essential for effective economic activity and health service delivery.

Beyond infrastructural failures and associated disruptions to supply chains, cold chains and productivity, systemic issues – including food insecurity, workers' rights, just-in-time manufacturing and supply chains, continued use of fossil fuels, displacement and conflict – aggravate the conditions for the creation and propagation of heat risk and sensitivity to it. Furthermore, mechanical cooling (e.g. air conditioning and refrigeration) also drives up energy usage, which increases greenhouse gas emissions when non-renewable energy sources are used, thus further accelerating global heating and creating a feedback loop that compounds the heat challenge even more.

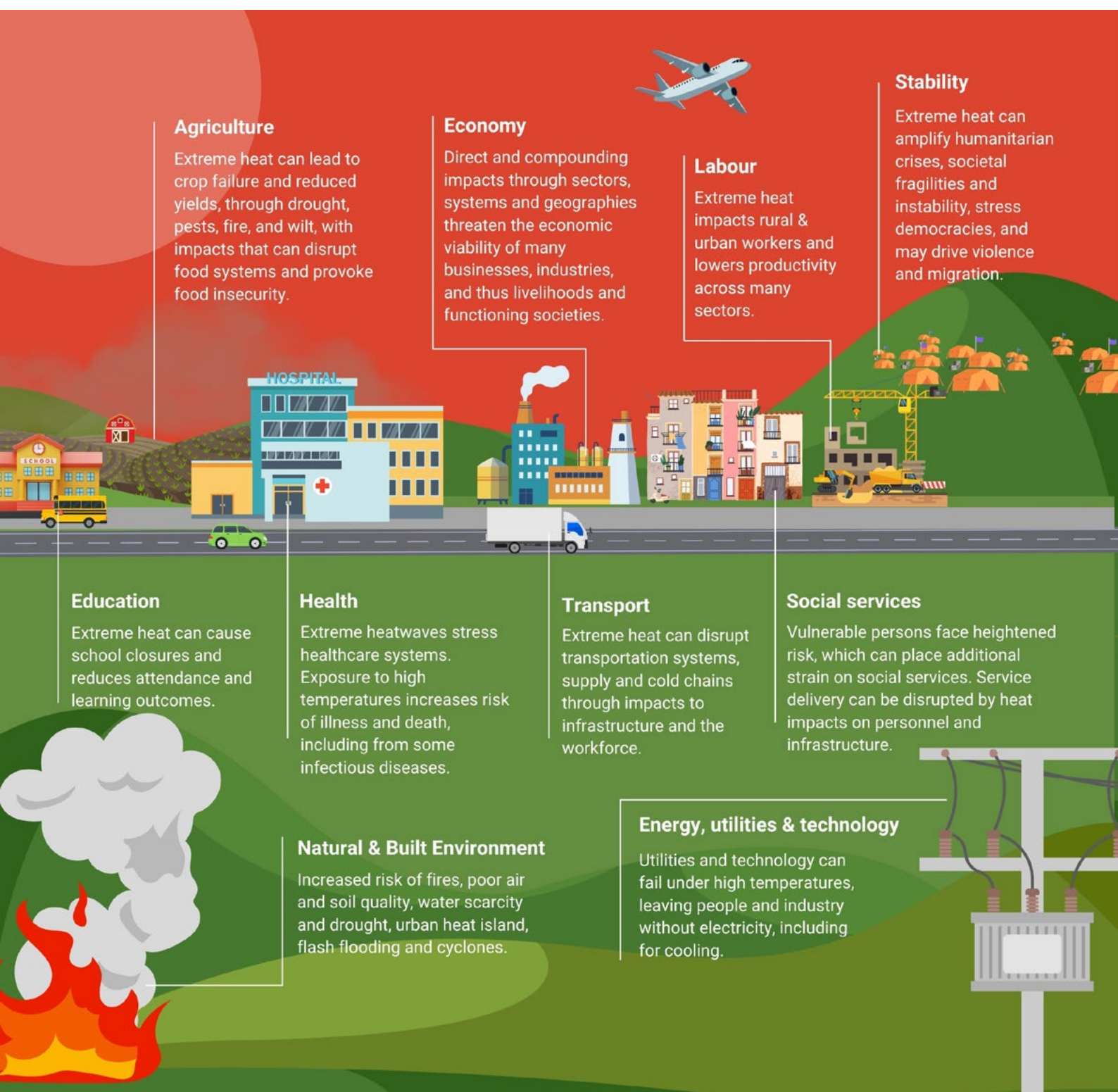
Heat stress in the world of work is of principal concern. Outdoor labourers or workers in facilities with poor ventilation face hazardous working conditions, resulting in reduced working hours and productivity losses that indirectly contribute to economic instability. These effects are most pronounced in lower-income populations, who often lack access to cooling, healthcare, insurance and other supportive resources, deepening existing social inequalities.

Current agricultural and food system practices drive heat risk due to occupational labour exposure to heat and heavy fossil-fuel dependence for production, transport and storage. At the same time, food systems are increasingly vulnerable to disruptions and even collapse from rising heat. Heat stress reduces crop yields and fisheries outputs, affecting food security and increasing costs for farmers on land and water. Livestock also suffers from heat exposure, leading to revenue and productivity losses in the agricultural industry. Furthermore, populations struggling with limited access to adequate nutrition are more vulnerable to heat-related illness and agricultural shocks driven by heat extremes.

In fragile and conflict-affected areas, weak coordination, limited public services, low state capacity and ongoing insecurity constrain the ability of decision makers in governments, communities and beyond to deliver and implement heat action plans, early warning systems or public health responses.

Systemic failures, such as those described above, contribute to driving extreme heat risk. The vulnerabilities of such systems not only increase the direct health, social and ecological impacts of extreme heat but also hinder effective, coordinated responses, allowing risks and impacts to cascade and grow across sectors, scales and population groups over time. The rising number of acute heatwaves and low-intensity but prolonged heat episodes means that both short-term emergency measures and long-term risk prevention, risk mitigation and adaptive strategies are required. To tackle extreme heat risk effectively, its multi-dimensional characteristics and impacts must be understood and addressed in an integrated manner (see Figure 2), hence the Extreme Heat Governance Framework and Toolkit.

Figure 2: Multi-sectoral and cascading impacts of extreme heat

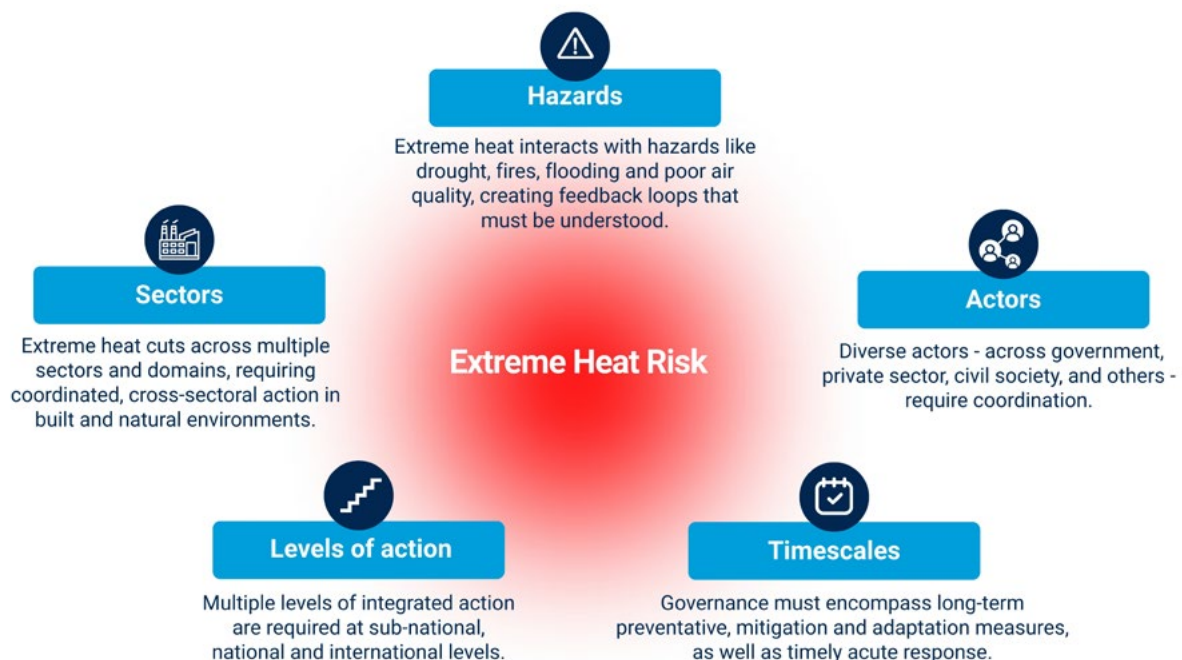


Understanding extreme heat risk governance

Extreme heat risk governance is a process whereby actors (e.g. government officials, community leaders, civil society, business owners, etc.), institutions (e.g. ministries, utilities, health sector, etc.) and assets (e.g. data systems, cooling centres, urban planning tools, etc.) are brought together across timescales of action to guide, coordinate and oversee heat risk reduction and related areas of policy, investment and action¹⁸.

These timescales span short-term emergency response and early warning systems, medium-term seasonal mitigation and preparedness, and long-term risk prevention, reduction and resilience. Such approaches seek to tackle the multiple dimensions of extreme heat risk (see Figure 3).

Figure 3: Multiple dimensions of extreme heat risk



¹⁸ United Nations, 2016. [Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction](#). United Nations General Assembly (A/71/644)

Effective extreme heat risk governance is guided by a set of core principles: being people-centred, holistic, equitable, inclusive, agile, collaborative, proactive, whole-system and evidence-based.

As represented in Figure 4, extreme heat risk governance is the mobilization and empowerment of actors, institutions and assets:¹⁹

- Across sectors and administrative levels
- To facilitate integrated, heat risk-sensitive decision-making, investment and programming that protects lives and livelihoods
- Across all the relevant risk time frames. This encompasses long-term resilience building and risk reduction, but also seasonal preparedness, early warning and emergency response.
- While deploying and ensuring commitment to good principles, across people-centredness, inclusion, equity, collaboration and others

Figure 4: Extreme heat risk governance operationalizes actors, institutions & assets, across timescales



¹⁹ Keith Ladd, Sara Meerow, David M. Hondula and others, "[Deploy heat officers, policies and metrics](#)", Nature, 598(7879), 29–31 (2021). DOI: 10.1038/d41586-021-02677-2.

3.1. Actors, institutions and assets

Extreme heat risk governance operationalizes actors, institutions, and assets, as shown by the exemplars in **Figure 5**. All three components need to be effectively mapped and engaged in order for governance to be successful.

Figure 5: Examples of actors, institutions and assets

Multi-sectoral coordination	Actors	Institutions	Assets
Definition	Individuals or informally organized groups of people who have a role in heat risk governance, such as government officials, private sector leaders, investors, politicians, vulnerable groups, and journalists.	Organizations, formal and informal, with a role in managing heat risk, such as government ministries, city governments, power and water utilities, private sector organizations, and workers groups.	Infrastructure, knowledge, and resources to support actors and institutions, such as hard assets (e.g. cooling centers, low-carbon energy generation), soft assets (e.g., local knowledge, analytical tools, legislation and regulation), as well as public / private capital and ecosystems services
Examples (non-exhaustive)	Government officials, policy leaders and politicians Healthcare and social protection actors Private sector and economic stakeholders Community leaders Researchers Media and communication actors	Governmental agencies Energy and infrastructure providers Healthcare and emergency services International and multi-lateral institutions Community-based organizations Private sector institutions	Weather data and forecasting Demographic and epidemiological data Community-level facilities and assets Operational information and technology Urban planning and architectural knowledge and resources Private markets and financing

3.1.1. Actors

Actors are the individuals, or formally or informally organized groups of people who have a role in extreme heat risk governance, such as government officials, business leaders, investors, civil society members, academics, journalists and vulnerable groups. In this toolkit, actors are people or groups of people, though their role, attributes, vulnerabilities, capacities, capabilities and interest in extreme heat may be highly variable.

Some of the key actors identified through consultations on this toolkit have included:

- Government officials, policy leaders, politicians, regulators (e.g. ministries of environment, health (with responsibility for public health agencies), education, transport, finance, energy, water and agriculture; city councils; urban planning departments and national disaster risk management officials) at national and subnational levels
- Private-sector and economic stakeholders (local business owners, energy systems coordinators, landowners, housing association representatives and officials of financial regulatory and supervisory bodies)
- Urban and infrastructure actors (urban planners, architects, housing association representatives, officials and operators of transportation services)
- Researchers and research institutions, academics and academic partners (including climate and weather services, public and global health professionals, (environmental) economists, social and cultural anthropologists and ecosystems services experts)

- f. Healthcare and social protection service actors (public healthcare and health system professionals, social protection and emergency support actors)
- g. National disaster risk management agencies and emergency services (emergency management and civil protection officials, firefighters and national guard members)
- h. Professionals from multilateral, international and non-governmental organizations
- i. Community and Indigenous peoples' leaders, representatives of grass-roots organizations, faith groups, informal settlements, social workers and citizens
- j. Media and communication actors

3.1.2. Institutions

Institutions are the organizations with a role in managing extreme heat risk, such as ministries, city government authorities, power and water utilities, regulators or private-sector organizations. Institutions are distinct from actors, notably in respect of the differing levels of influence of an individual versus an institution. Institutions generally provide a more standardized or homogenized framework for action within a specific policy area.²⁰

This toolkit uses “institutions” instead of “organizations” to encompass both formal groups (e.g. ministries of finance or utility providers) and informal societal groups (e.g. grass-roots organizations).

Some of the key institutions identified through consultations on this toolkit have included:

- a. Government agencies and public bodies (ministries of finance, agriculture, environment, energy, water, health, labour and planning; regulatory authorities; central banks; national environment agencies; national public health institutes; subnational governments, municipal authorities, etc.)
- b. Energy and infrastructure institutions (energy and power generators and distributors, utility providers and other infrastructure services)
- c. Healthcare and emergency services (hospitals, primary healthcare, ambulance services, first responders, health and environmental management)
- d. National disaster risk management agencies and emergency services (emergency management services, civil protection entities, fire services and national guard)
- e. Private-sector and economic institutions (businesses, chambers of commerce, inventors, banks, financiers and investors, industry bodies and associations)
- f. Media and communication institutions
- g. International and multilateral organizations (multilateral development banks and organizations, United Nations and international non-governmental organizations)
- h. Community-based and civil-society organizations (including those that are locally led, refugee led, etc.)
- i. Research and academic institutions (meteorological services, climate prediction centres, universities, research institutes and think tanks)

3.1.3. Assets

Assets are the physical or technological infrastructure, knowledge and resources that can support actors and institutions in reducing extreme heat risk. These may include cooling centres, data holdings, analytical modelling tools for heat forecasting, low-carbon energy generation equipment or ecosystem services and nature-based solutions. This toolkit also encompasses less tangible assets, such as local knowledge about effective residential cooling systems. The toolkit is dependent upon, aligned with and supports the mobilization of financial assets and resources – both public and private – for effective extreme heat risk governance and reduction.

²⁰ Robbert Biesbroek, “Policy integration and climate change adaptation, Current Opinion”, *Environmental Sustainability*, 52, 75–81 (2021), DOI: 10.1016/j.cosust.2021.07.003.

Some of the key assets identified through consultations on this toolkit have included:

- a. Weather services, including data-collection systems, forecasting models, decision-support information and technologies for early warning and other life-saving information services
- b. Demographic and epidemiological data sets, identifying who is most vulnerable and where they live, as well as public health surveillance data and systems to understand the health impacts of extreme heat (in real time)
- c. Health facilities, cooling centres, first-responders' personnel and equipment, mobile units to deliver water, ice and wellness checks to outdoor workers, and other acute response needs
- d. Economic data sets, for example on the type of economic activity and the shape of the outdoor labour market in a particular space
- e. Vulnerability data sets, including socioeconomic, structural and ecological vulnerability data, among others
- f. Information and technology to monitor, prevent and mitigate impacts on utility operations and service delivery
- g. Capital funding and finance – both domestic and international, public and private – and enabling regulation and legislation for integrated and coordinated heat risk-informed investment
- h. Urban planning and design, knowledge and resources (tools, techniques and innovations) including to reduce urban heat island effects
- i. Ecosystem services and nature-based solutions
- j. National hubs (command centres, focal points, emergency operations centres, development oversight bodies, etc.)
- k. Local knowledge and Indigenous wisdom

3.2. Multi-hazard, multi-temporal risk and action

Extreme heat risk, as a function of multiple drivers, is systemic and does not occur in isolation. When coupled with other conditions or hazards, it can drive or amplify the risk of wildfire, flooding, drought and water stress, air pollution, storms and epidemics.

Similarly, impacts can be exacerbated when combined with the underlying conditions that give rise to other events.²¹ Such impacts may occur simultaneously, in cascade or cumulatively;²² extreme heat, air pollution and humidity, for example, can significantly increase harm.

Taken alone or in combination with other hazards or stressors, when heat risk manifests as an extreme heat event, it can initiate a chain of subsequent impacts across interdependent sectors or systems. These cascades can provoke sequential failures or feedback loops. Such domino or knock-on impacts, where a failure in one system (e.g. a power grid) leads to secondary consequences (e.g. loss of cooling and healthcare failures)²³ or tertiary consequences (e.g. economic disruption), are common, with impacts that manifest through time, and across sectors and geographies.

Addressing interconnected and compounding drivers of extreme heat risk and cascading impacts must therefore be addressed in an integrated manner, co-managed and undertaken as part of multi-hazard risk reduction approaches. The multi-temporal nature of extreme heat risk drivers, and their impacts when realized, require governance that is capable of functioning across these timescales, as shown by the exemplars in Figure 6.

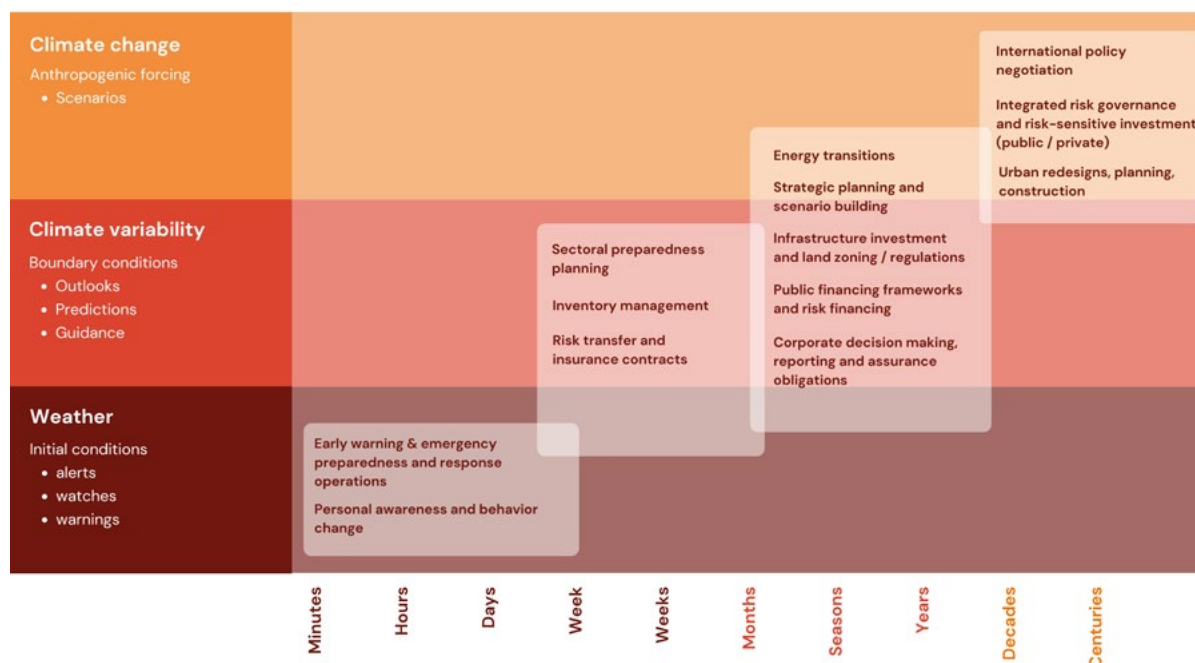
21 [IPCC Special Report on Managing the Risks of Extreme Events and Disasters](#) (SREX, 2012).

22 [Report of the open-ended intergovernmental expert working group on indicators and terminology relating to disaster risk reduction](#). United Nations General Assembly (A/71/644).

23 Nicholas P. Simpson, Portia Adade Williams, Katharine J. Mach and others, "Adaptation to compound climate risks: A systematic global stocktake", *iScience*, 26(2) 105926 (2023). DOI: 10.1016/j.isci.2023.105926.

Figure 6: Extreme heat risk drivers and impacts exist across timescales, dictating heat risk management decisions

Note: Figure 6 provides an illustrative, rather than exhaustive or precise overview of the diverse timescales across which extreme heat risk must be managed. In offering various exemplar heat actions it highlights that effective heat risk governance spans long term risk prevention, mitigation and resilience building through to heat crisis preparedness, response and recovery.



Integrated and co-managed approaches to extreme heat risk governance within multi-hazard frameworks can deliver multiple dividends, saving lives, strengthening health, food and urban systems, improving energy efficiency, protecting ecosystem health, and advancing social and economic well-being. By recognizing that heat risk both interacts with and amplifies other hazards, investments in heat risk governance not only reduce immediate risk but also contribute to climate adaptation and mitigation, social protection and long-term development goals, and societal functioning.

3.2.1. Long-term action: resilience and risk reduction

Building resilience to extreme heat calls for investments in behaviour and market change, policy and infrastructure. By integrating scientific research, enabling policy, regulatory and legislative measures for integrated information systems, decision-making, innovative finance and investment, capacity-building and local engagement strategies, societies can build sustained support for long-term resilience to extreme heat. Coordinated efforts – across public health, energy, urban planning and disaster risk management, for example – that recognize other risks will be essential to addressing extreme heat risk drivers and mitigating, managing and adapting to the intensifying impacts of climate change. Innovative public and private finance and capital is crucial, provided it is shaped by the systematic use and application of heat risk quantification and analytics, and by economic and financial valuation, thereby promoting sustainable investment. Ensuring proactive governance and investment, including in climate change adaptation and mitigation, can safeguard human health, economic stability and environmental sustainability in a warming world.

For example, urban planning and (re)design are central to reducing heat risks, with cities implementing green infrastructure solutions such as urban tree planting, green roofs or artificially shaded public spaces to counteract the urban heat island effect. Additionally, mixed-use development and urban planning that prioritize active mobility and sustainable transport can help reduce dependency on cars, thereby lowering sources of human-

caused heat in cities. Using reflective and heat-resistant materials, establishing improved ventilation standards in building construction and undertaking climate-resilient retrofits of the existing building stock can reduce indoor temperatures and lessen dependency on energy-intensive (and heat-emitting) cooling systems. Governments should enforce building codes that maximize passive cooling techniques and thermal efficiency. Such standards should also inform shelter design and site planning for displaced populations and informal settlements, where inadequate materials and overcrowding often amplify heat stress. Governments can incentivize climate-sensitive design, for example through subsidized access to appropriate materials (such as reflective or insulated roofing), technical training for local builders, community demonstration projects drawing on vernacular architecture microcredit or financial support for heat-resilient upgrades, and so on.

Approaches to energy use and efficiency, power generation and distribution are critical components of extreme heat risk reduction. Energy systems' resilience is also critical in reducing heat-related disruptions. Power grids should be designed or modernized to handle increased demand during heat events, and alternative cooling solutions such as district cooling systems should be explored. Renewable energy investments, including in solar and wind power, can reduce reliance on carbon-based cooling systems that exacerbate climate change. Accelerating a just transition away from fossil fuels and scaling up investment in renewable energy sources are arguably the most important actions in tackling the root causes of extreme heat risk.

With over 70 per cent of the global workforce at high risk of extreme heat, governments and employers can establish or strengthen occupational health and safety measures that significantly reduce workplace accidents, injuries and deaths, not to mention heat-related productivity losses. Rights-based approaches will guarantee workers' rights to a safe and healthy working environment, knowledge about heat stress and removing themselves from situations of imminent or serious danger. Together with revisions to laws on occupational health and safety to incorporate provisions for extreme heat, tailored strategies for different sectors and improved surveillance and reporting mechanisms for heat stress in the workplace, worker protection can be assured.

Community engagement is essential in fostering resilience at the local level. Public education campaigns can improve awareness of heat risks. Inclusive and participatory approaches can ensure that community knowledge, traditional coping practices and lived experience inform decision-making at all levels. Such approaches can encourage behavioural and market-based changes that reduce heat exposure. Community-led initiatives, such as local heat emergency response teams and neighbourhood cooling programmes, can provide direct support to vulnerable populations. Policies that promote equitable access to cooling resources, including subsidized air conditioning for low-income households and increased public access to shaded spaces, are crucial for reducing heat-related disparities.

Engagement should also be prioritized in educational settings, by incorporating climate change- and heat-related content into curricula for children, as well as for health professionals in training. Adopting green and climate-resilient measures, such as renewable energy and rainwater harvesting, can help health facilities to continue delivering health services during heat-induced disruptions.

Often overlooked in favour of short-term extreme heat crisis management and response actions, long-term measures addressing the root causes of extreme heat risk and resilience to heat impacts are among the most urgent actions to address, both nationally and globally. These will require a whole-of-government, all-of-society approach that encompasses, for example, ministries of finance and those responsible for infrastructure, urban development, food, transportation and energy system planning and design.

3.2.2. Medium-term actions: seasonal mitigation and preparedness

While hot seasons occur in all climate zones, temperature swings are most pronounced in temperate regions. Seasonal preparedness refers to efforts to reduce and manage risks in advance of a predictable annual seasonal rhythm of high temperatures. While it does not allow the kind of long-term prospective and preventative investments and actions at the heart of long-term resilience measures, the seasonal response time frame (three to six months) allows for the mobilization of a wide range of actors, institutions and assets – including processes such as information sharing or arranging task forces – in a planned and orderly way when the risks are most likely to manifest as heat shocks. This is often a priority for programmatic planning, for example in local health and

agricultural departments.

In humanitarian settings, seasonal preparedness plans developed through inter-cluster coordination should include heat-related contingency actions, such as ensuring reliable access to water, temporary shading and surge medical capacity in camps or informal settlements. In displacement settings, community-based disaster risk reduction (DRR) committees and site management structures can be leveraged to strengthen locally owned early action and preparedness. Coordination mechanisms, such as the cluster system and Humanitarian Country Teams, can play a critical role in aligning early recovery, risk reduction and resilience objectives across sectors and actors.

3.2.3. Short-term actions: early warning systems and emergency response

Managing extreme heat in the short term, mostly during the heat season, requires a combination of early warning systems and emergency response measures. In the immediate term, early warning systems can provide timely alerts to vulnerable populations, allowing them to take necessary precautions, provided they are aware of the warning and understand what actions to take. Public cooling centres offer refuge during heatwaves, particularly in urban areas where access to cooling is limited. Hydration and heat safety awareness campaigns can educate at-risk populations on the importance of staying cool and preventing heat-related illnesses.

Strengthening public health surveillance systems and modernizing them through the use of digital technology are critical, not only to monitor health impacts for preparedness and response but also to integrate early warning systems and monitor the impact of climate action. Healthcare systems must be prepared for an influx of heat-related cases by expanding medical capacity during heat emergencies. This is typically the most important agenda for emergency responders.

Increasingly, with a humanitarian risk requiring multisectoral contingency planning, preparedness protocols should also include anticipatory actions, such as pre-positioning of medical and water, sanitation and hygiene (WASH) supplies and activating mobile outreach teams in high-risk areas. In displacement settings, cluster-led coordination – particularly across health, WASH and shelter – can ensure targeted outreach and resource delivery during heatwaves.

3.3. Core principles of extreme heat risk governance

Actions and approaches that operate according to a set of common, good-practice principles can help to mobilize and engage a diverse range of actors, institutions and assets effectively over the three timescales in effective heat risk governance. National and international experts contributing to the development of the Framework and Toolkit identified the following principles as the most important if actions addressing extreme heat risk are to be successful:

1. **People-centred:** All actions are taken with a view to improving or protecting the lives and livelihoods of the people living or working in or visiting the area, in a manner that is acceptable to them. A people-centred approach that reflects the context requires a detailed understanding of the psychology, preferences and constraints of the actors involved and most importantly, the vulnerable groups to be protected. Public and civil society engagement and integrating local knowledge are therefore essential elements of good governance.
2. **Holistic and interconnected:** Extreme heat has cascading effects, not only on people but on animals and ecosystems as well. A holistic and interconnected approach recognizes that human health, well-being and economic stability depend on the vitality and balance of the natural ecosystems that sustain life. Healthy ecosystems provide essential services such as clean air, water, food and cooling. By integrating environmental, animal and human health considerations, governance efforts address heat risks that

safeguard both people and the planet.

3. **Equitable and just:** All groups are supported and there are special efforts to remove inequitable and unjust barriers to risk reduction and to ensure an equitable and just application of heat solutions. For example, if particular individuals are exposed to increased risk because of their income, occupation, gender or identity, or if they are excluded due to living or working in informal settings, special efforts should be made to reduce extreme heat risk for these particularly vulnerable groups.
4. **Inclusive:** The full range of relevant actors and institutions are engaged and any barriers to full inclusion are removed, whether these are barriers of language, trust, accessibility or socioeconomic status. Inclusivity also means working with those who are working to address the drivers of the heat risk (e.g. climate change mitigation), as well as those working to reduce it, and adapt and respond to extreme heat.
5. **Agile:** Quick feedback loops between demand, planning, action and learning back into demand. This dynamic cycle allows for adaptations and changes in response to implementation to be incorporated rapidly, improving risk reduction over time.
6. **Collaborative:** Processes are designed to build solutions based on the collective expertise of diverse and different teams, through consultation, deliberation and shared responsibility for action.
7. **Proactive:** Governance mechanisms are proactively formed with a view to developing long- and medium-term measures long before an emergency materializes and thus are not neglected during times of non-crisis, helping prevent and mitigate risks, anticipate and create adaptive responses in advance of their impacts being felt. Critically, proactivity also means addressing the fundamental drivers of extreme heat, particularly through climate change mitigation and reducing the urban heat island effect in cities.
8. **Whole-system:** Governance considers and involves all relevant actors, with leadership distributed across the full range of institutions, sectors, geographical layers and interest groups that have a role to play in extreme heat risk governance, and identifies the dependencies in systems that can drive heat risks and create vulnerabilities or strengths.
9. **Evidence-based:** Attention and resources are dedicated to generating and collecting accurate heat risk data and analysing data to derive actionable insights that are accessible and drive evidence- and thus risk-informed decision-making in a consistent, impact-focused way.
10. **Diversified and sufficient resources:** The governance process is supported by financial and non-financial resources from relevant public and private sources, commensurate with the level of extreme heat risk and sufficient to ensure actors, institutions and assets are adequately mobilized in an integrated and sustained way across sectors and scales.

These good principles underpin, facilitate and sustain the extreme heat governance approach, by ensuring it is rooted in good practices and legitimized in the eyes of actors and institutions. Without sufficient attention in ensuring these principles are applied in the design and operationalization of extreme heat risk governance, efforts can become fragmented, inequitable or unsupported by key constituents. This can undermine trust, reduce participation and ultimately hamper the effectiveness of extreme heat risk governance efforts.

How to use the toolkit

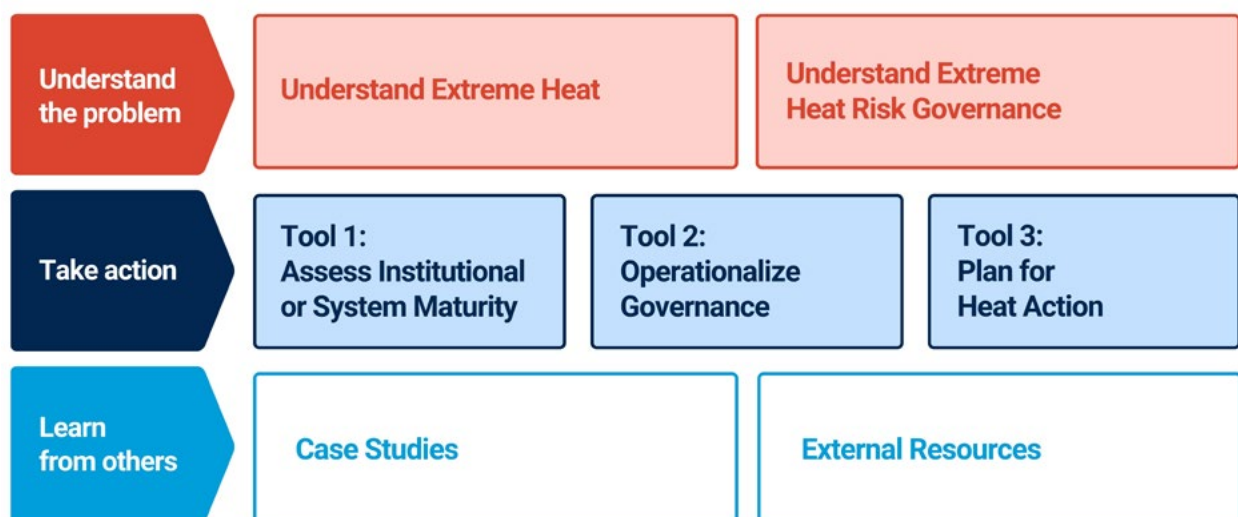
This toolkit was developed in response to the call by governments and their partners for clear, actionable guidance on how to prevent, reduce and manage extreme heat risk and its impacts. It is not intended to be a definitive and comprehensive solution to extreme heat risk governance challenges; rather, it seeks to provide practical options, resources and pathways to help actors to strengthen extreme heat risk governance at multiple geographic scales (regional, subnational, urban, etc.) and across multiple sectors and domains. More specifically, this includes equipping governments, responsible authorities and other relevant stakeholders with the frameworks, tools, and real-world insights needed to establish or strengthen mechanisms or processes that can prevent and reduce extreme heat risks, protect lives, infrastructure and ecosystems, and promote sustainable development in an increasingly warming world.

This toolkit is intended for decision makers at all levels – from local to national and international – and across sectors and domains. It will be particularly relevant to government officials, policy advisors, civil society actors, public and private finance and investment officers, and academics involved in risk reduction, infrastructure and utilities, environmental management, health and education services, and social protection from climate risk. While applicable to a wide range of potential uses, the material here will be of greatest use to national governments and local authorities engaged in extreme heat risk governance across multiple sectors.

4.1. Structure of the toolkit

The toolkit is organized into three main sections: Understand the problem, Take action, and Learn from others. These interconnected sections build a comprehensive understanding of extreme heat risk and the governance systems needed to address it (see Figure 7).

Figure 7: Structure of the Extreme Heat Risk Governance Toolkit



4.2. Understand the problem

Lays the foundation by defining extreme heat and the principles of extreme heat risk governance, equipping users with the essential knowledge to apply the toolkit's resources.

Understand Extreme Heat

Explores the definitions, indicators and metrics used to characterize extreme heat, highlighting health, infrastructure and environmental impacts. It also examines the drivers and cascading consequences of extreme heat events across different contexts.

Understand Extreme Heat Risk Governance

Introduces the concept of extreme heat risk governance, focusing on the coordination of actors, institutions and assets across all timescales – from emergency response, adaptation, mitigation and prevention to long-term resilience – and grounded in principles such as collaboration, equity and co-designed, data-driven and evidence-based decision-making.

4.3. Take action

Introduces three practical tools that decision makers at all levels can use to strengthen heat resilience. These tools offer actionable frameworks, guidance and examples to support cross-sectoral efforts across different timescales.

Tool 1: Maturity assessment – Assess the maturity of your Extreme Heat Risk Governance

Provides a self-assessment tool to help planners and decision makers²⁴ evaluate the maturity and readiness of their current extreme heat risk governance mechanisms across five key components and identify areas for targeted improvement.

Tool 2: Operationalize Extreme Heat Risk Governance

Presents a governance cycle approach, namely demand, plan, act and learn, offering practical guidance to translate political will and constituency needs into integrated policies, programmes and investments.

Tool 3: Plan for Heat Action

Details the essential components and good practices for creating or strengthening a Heat Action Plan, ensuring that actions are effective, inclusive and tailored to evolving risk conditions.

4.4. Learn from others

Provides a curated set of additional resources designed to foster learning from diverse geographic and governance contexts, including:

Case studies – Insights from 13 countries that have implemented diverse approaches to extreme heat governance. These studies highlight real-world challenges and successes across different governance levels, enabling users to identify strategies and common barriers.

External resources – External resources across key sectors such as the economy, legislative frameworks, infrastructure, social protection and others. Resources cover studies and guidance on governing extreme heat risk and building resilience, including technical guidelines, articles, proposals, and additional case studies.

²⁴ With particular relevance to government officials, policy advisors, civil society actors, private sector and finance representatives, and academic experts.

Tool 1: Assess the maturity of your Extreme Heat Risk Governance

The Extreme Heat Governance Assessment Tool is designed to help governments and their partners evaluate and improve their approach to strengthening resilience. The assessment tool provides these stakeholders with a straightforward way to assess their current situation in critical dimensions and then identify areas to strengthen and improve. Based on the United States' National Integrated Heat Health Information Systems (NIHHIS) [Maturity Model for Heat Governance](#), this streamlined version serves as an entry point for understanding the development of heat resilience. While the NIHHIS Maturity Model offers deeper complexity, this modified toolkit provides an accessible starting point for governments at all levels to begin evaluating and improving their extreme heat governance mechanisms.

The assessment tool allows practitioners and policymakers to evaluate their heat governance capabilities across five key dimensions: recognition, leadership, response, resources and collaboration.



5.1. Self-assessment tool

Figure 8: Maturity Model for Heat Governance

		STAGE 1 ISOLATED ACTION & AWARENESS Score 6-8	STAGE 2 EMERGING STRUCTURES & FOCUSED INITIATIVES Score 9-14	STAGE 3 INTEGRATED ACTION & CAPACITY BUILDING Score 15-20	STAGE 4 MATURE HEAT GOVERNANCE Score 21-24
GOVERNANCE MODEL COMPONENT	DIMENSION				
Demand	Recognition	Heat risks are acknowledged only during extreme events; awareness is limited.	Heat is identified as a growing issue for public health and resilience; awareness campaigns target vulnerable populations and key stakeholders.	Heat risks are integrated into disaster risk reduction and climate adaptation strategies; awareness campaigns reach across sectors and communities.	Heat is addressed as part of systemic challenges like urbanization, inequality, and climate change; there is a culture of awareness.
	Leadership	There is no designated leadership or clear accountability for heat governance.	Informal or emerging leadership begins to take responsibility for heat risks.	Formalized roles (e.g., heat officer/agency) with documented responsibilities are established.	Heat resilience is defined in protocols, policies, and procedures to sustain governance through changes in leadership.
Plan	Response	Responses are reactive and crisis-driven and there is minimal public engagement or messaging on heat-related risks.	Initial development of early warning system begins and public awareness campaigns based on event rarity and seasonal heat risk are launched; there are some pilot projects for outreach.	Heat action plans are developed and implemented, improving warning systems to target vulnerable groups and with multimodal outreach and messaging.	There are comprehensive, anticipatory strategies (e.g., urban cooling, nature-based solutions resilient infrastructure) that integrate across sectors and governance levels to ensure long-term adaptation.
	Resources	There is limited funding, staff capacity, and infrastructure to address heat impacts.	Project-based or time-limited funding and staff capacity support early initiatives.	Multi-year funding and assigned staffing ensures stability for heat programs and initiatives.	Permanent funding, dedicated staffing, and robust infrastructure support systemic heat risk management.
Act	Collaboration	Efforts are siloed; there is no coordination across sectors or governance levels.	Pilot level partnerships among public, private, and academic sectors start to form; however, collaboration tends to be opportunistic and ad hoc with limited structure and planning.	Inter-agency coordination and partnerships with external organizations are launched, including joint initiatives or programs, creating stronger linkages across levels of governance.	Formalized partnerships exist across relevant sectors (public, private, nonprofit, and academic) and levels of government, leading to policy innovation.
Learn	Learning & Improvement	Evaluation is reactive and sporadic. Learning happens after crises through external reviews. Success metrics are unclear.	Programs have clear goals and indicators for better monitoring and evaluation, but learning remains siloed and inconsistently applied.	Learning mechanisms are embedded in planning and action. Evaluation is continuous and lessons learned regularly inform decision-making.	Learning is adaptive, iterative, applicable to complex challenges. Local lessons are shared across regions, and governance evolves based on insights.

How to use the tool

For each dimension, decision makers can identify their current stage of development along a four-stage progression, from Stage 1 (Isolated Action & Awareness) to Stage 4 (Systemic Resilience).

To use the tool, decision makers should review the descriptions provided for each dimension and stage, identifying which best matches their current governance mechanism. The visual progression along the curve helps users gauge their progress on the path to heat resilience and identify their next steps. For example, a government might find that it is at Stage 2 in its recognition of heat as an issue, but only at Stage 1 in terms of dedicated resources and infrastructure.

The dimensions of the maturity assessment tool align closely with the model for operationalizing Extreme Heat Risk Governance, as described in **Tool 2** of this toolkit. For example, “Demand” in the governance model correlates to “Recognition” and “Leadership” in the maturity assessment tool. Likewise, “Plan” in the governance model correlates to “Response” and “Resources” in the tool, while “Act” in the governance model correlates to “Collaboration”. Finally, the “Learn” component of the governance model is directly related to the “Learning and Improvement” dimension of the maturity assessment.

The Extreme Heat Governance Self-Assessment Tool is not meant to evaluate specific strategies for heat action; rather, it provides a high-level assessment of the governance frameworks within which such strategies should be developed. Considerations over cultural norms and practices or other place-based considerations are best incorporated into Heat Action Planning (see Appendix to **Tool 3**: Heat Action Plan Assessment).

By identifying their current position across these dimensions, governments and their partners can better understand their strengths and gaps in heat resilience, helping them prioritize improvements and work toward more integrated, systematic approaches to reducing and managing heat-related risks across sectors and timescales.

To identify what stage they are at overall, decision makers can complete the questionnaire and scoring guide.

5.2. Heat governance self-assessment questionnaire

1. How are heat risks recognized in your country?

- a. Heat risks are acknowledged only during extreme events; awareness is limited.
- b. Heat is identified as a growing issue for public health and resilience; awareness campaigns target vulnerable populations and key stakeholders.
- c. Heat risks are integrated into disaster risk reduction and climate adaptation strategies; awareness campaigns reach across sectors and communities.
- d. Heat is addressed as part of systemic challenges like urbanization, inequality, and climate change; there is a culture of awareness.

2. How are leadership and accountability for heat governance assigned and/or structured in your country?

- a. There is no designated leadership or clear accountability for heat governance.
- b. Informal or emerging leadership is beginning to take responsibility for heat risks.
- c. Formalized roles, such as a heat officer or agency, are established with documented responsibilities.
- d. Heat resilience is defined in protocols, policies and procedures to sustain governance through changes in leadership.

3. How are heat risks addressed through actions and public engagement in your country?

- a. Responses are reactive and crisis-driven, with minimal public engagement or messaging about heat-related risks.
- b. Early warning systems and public awareness campaigns are in initial development, based on event rarity and seasonal heat risks, with some pilot projects for outreach.
- c. Heat action plans have been developed and implemented, improving warning systems to target vulnerable groups, providing multimodal outreach and messaging, and heat risk vulnerability is assessed and included in service delivery planning, urban cooling and urban development.
- d. Comprehensive, prevention, mitigation and anticipatory strategies – such as urban design, resilient infrastructure and cross-sectoral decision-making (e.g. transport, health, housing and labour) – are integrated across sectors and governance levels to ensure long-term resilience and adaptation.

4. What level of funding and infrastructure exists to support heat resilience efforts in your country?

- a. There are insufficient funding, staff capacity, and infrastructure to address the scale of heat drivers and impacts.
- b. Project-based or time-limited funding and staff capacity support early initiatives.
- c. Multi-year funding and assigned staffing ensures stability for heat programmes and initiatives.
- d. Permanent funding, dedicated staffing and robust infrastructure support systemic heat risk management.

5. How well coordinated are efforts to address heat risks across sectors and governance levels in your country?

- a. Efforts are siloed, with no coordination across sectors or governance levels.
- b. Pilot-level partnerships among the public, private and academic sectors are starting to form, but collaboration is often opportunistic and ad hoc, is not supported by formal partnership arrangements, with limited structure and planning, and is dependent on individuals and relationships only.
- c. Inter-agency coordination and partnerships with external organizations, exist, including joint initiatives or programmes, creating stronger linkages across governance levels.
- d. Formalized partnerships exist across relevant sectors – public, private, nonprofit and academic – and levels of government, leading to policy innovation and coordinated action.

6. How does your organization integrate learning and evaluation into its operations?

- a. Evaluation happens rarely, reactively and sporadically. Learning occurs after crises through external reviews. Success metrics are unclear.
- b. Programmes have clear goals and indicators for better monitoring and evaluation, but learning remains siloed and inconsistently applied.
- c. Learning is embedded in planning structures. Evaluation is continuous with real-time data. Lessons inform decisions.
- d. Learning is adaptive and iterative in complex challenges. Local lessons are shared across regions, and governance evolves based on insights.

Scoring guide

Follow the steps below to determine your nation's Heat Governance Stage.

Step 1: Copy your answers from the questionnaire into column 2 of the scoring table. For each question number in column 1, write the letter (A, B, C, or D) that you selected as your answer.

Step 2: For each entry in column 2, assign a numerical score based on your answer choice: A = 1 point, B = 2 points, C = 3 points and D = 4 points. Enter these numerical scores in column 3.

Step 3: Add up all the numerical scores in column 3 to calculate your total score. Write your total score at the bottom of column 3.

Step 4: Use your total score to determine your Heat Governance Stage:

- Total score of 6–8: Stage 1 – Isolated Action & Awareness
- Total score of 9–14: Stage 2 – Emerging Structures & Focused Initiatives
- Total score of 15–20: Stage 3 – Integrated Action & Capacity Building
- Total score of 21–24: Stage 4 – Mature Heat Governance

Scoring table

Question	Answer	Score
How are heat risks recognized in your country?		
How are leadership and accountability for heat governance assigned and/or structured in your country?		
How are heat risks addressed through actions and public engagement in your country?		
What level of funding and infrastructure exists to support heat resilience efforts in your country?		
How well coordinated are efforts to address heat risks across sectors and governance levels in your country?		
How does your organization integrate learning and evaluation into its operations?		
Total		

Facilitating the assessment process

To ensure a shared and comprehensive understanding of the current governance landscape, it is recommended that the assessment be conducted through a facilitated workshop or structured consultation. The process should involve a broad range of institutions, including meteorological and hydrological services, health agencies, disaster risk management authorities, urban planning departments, energy and water management authorities, transportation, agriculture, finance and other relevant sectors, as well as civil society and academic partners. A brief orientation can familiarize participants with the five governance dimensions and the four maturity stages before scoring begins. Facilitators or those leading the activity should encourage open discussion around each dimension, helping participants reflect on evidence, examples and institutional practices. Capturing qualitative insights alongside the numerical score will enrich interpretation and ensure a more realistic picture of the system's maturity. The maturity assessment process can be supplemented by peer-to-peer challenge sessions (e.g. country to country, city to city or municipality to municipality), which can drive improvement and can build capacity in and of themselves.

5.3. Using and interpreting the results

After completing the scoring, facilitators should review the results collectively, identifying convergence or divergence in responses. This discussion is as important as the scores themselves: differences often reveal varying perspectives on mandates, data and capacities across institutions. Once consensus is reached, participants can use their overall maturity stage to determine next steps and link with subsequent tools in the framework.

Stage 1 – Isolated Action & Awareness

Focus should be placed first on creating demand and shared understanding for coordinated action. Engage senior leadership to establish a clear mandate for addressing heat risk. Use Tool 2: Operationalize Extreme Heat Risk Governance to initiate the Demand and Plan phases (i.e. mapping existing actors, clarifying responsibilities and identifying quick wins that demonstrate value).

Stage 2 – Emerging Structures & Focused Initiatives

The priority is to strengthen institutional coordination and planning mechanisms. Use Tool 2 to deepen the Plan phase and transition into Action: formalize intersectoral working groups, secure resources and integrate heat into existing risk management or climate programmes. Begin drafting a Heat Action Plan with Tool 3: Plan for Heat Action to align short-term preparedness with longer-term resilience goals.

Stage 3 – Integrated Action & Capacity-Building

Consolidate progress by scaling interventions and embedding heat governance into broader climate and health strategies. Use Tool 2 to emphasize the Act and Learn & Improve components by institutionalizing feedback loops, monitoring performance and updating policies. Strengthen Tool 3 outputs by formalizing and financing multi-year Heat Action Plans.

Stage 4 – Mature Heat Governance

Focus on sustainability, innovation, political buy-in and continuous improvement. Use Tool 2 to enhance cross-sectoral learning, data integration and long-term adaptation investments. With Tool 3, refine and replicate effective Heat Action Plans across jurisdictions, while sharing lessons with regional and global networks.

From assessment to action

By linking the maturity results directly to subsequent tools and steps, this section helps progress from a diagnostic exercise into the beginning of a strategic roadmap. Governments can use the findings to prioritize institutional reforms, capacity-building needs and investment opportunities, ensuring that each stage of progress is informed by data, collaboration and learning. Over time, repeated use of the tool can help measure growth, maintain momentum and strengthen accountability across institutions working to build heat-resilient societies.

Tool 2: Operationalize Extreme Heat Risk Governance

Having assessed the strengths and gaps of existing governance structures and processes in Tool 1, decision makers can next consider how to make improvements. Tool 2 sets out the full governance approach for extreme heat risk management to support that process, identifying the key components of each area and the questions and considerations that must be addressed to operationalize them effectively.

The governance approach

The approach to operationalizing extreme heat risk governance is grounded in four components, laid out in Figure 9:

1. **Demand** for action and investment
2. **Plan** for proactive and inclusive heat risk management
3. **Act** through systems, policies and investments
4. **Learn & Improve** to refine and strengthen response over time

Each of these components needs to be supported by the central **Data & Analytics** enabler, to support the identification of **Demand**, underpin the processes, budgets and targets within **Plan**, identify and monitor the metrics needed to **Act** and finally, support a robust process to **Learn & Improve**.

This four-component approach is designed to be adaptable to various circumstances across geographies and timescales, economic status, resource availability and diverse types of actors and institutions.

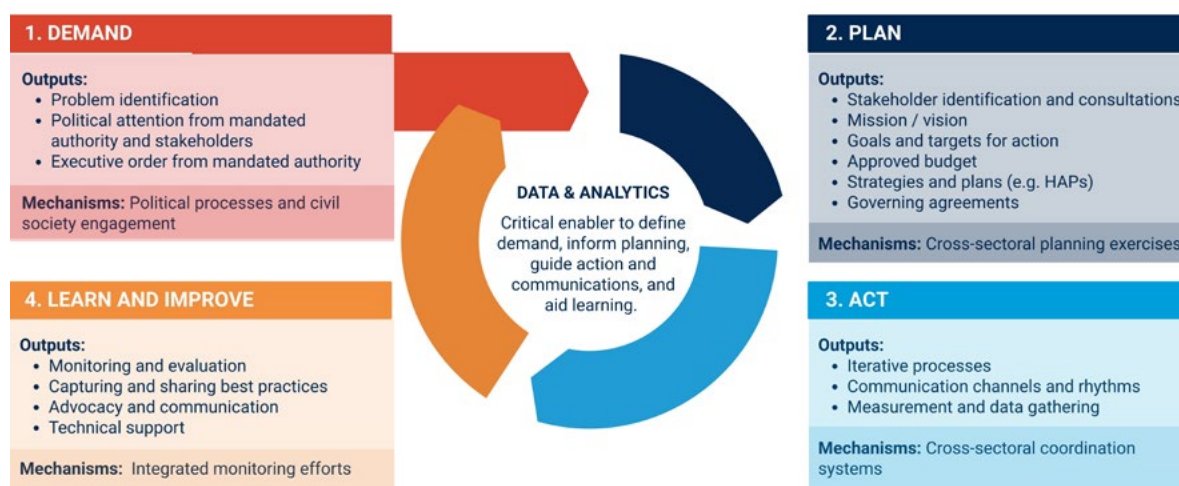
According to the above definition, “governance” applies to the processes through which public, private and civil society actors and institutions utilize and deploy assets to make decisions and define actions to guide, coordinate and oversee heat risk reduction and related areas of policy, with investment and action implemented across multiple timescales, sectors and geographies. These decisions may be statutory and regulatory solutions, but can also include decisions made by the private sector and non-government actors to govern extreme heat risks relevant to them.

In this model, governance is an *iterative, evolving process*. *Demand* for managing heat risk generates *planning* activities, which in turn lead to *actions*, based on which *learning & improvement* takes place, so that the demand for action and the planning process can be refined and sharpened in future iterations. Effective governance can only occur when each of these components of the cycle is optimized and they feed into each other effectively.

The governance cycle is designed to mobilize and empower multisectoral and multi-scalar components of actors, institutions and assets across all the relevant *risk response time frames*, most prominently long-term resilience and risk reduction, but also seasonal mitigation and preparedness, and early warning and emergency response. Good governance principles serve to guide and shape the cycle throughout.

Once a baseline has been established, it is possible to move towards operationalizing the model's governance cycle, through which actors, institutions and assets are mobilized and empowered across timescales. The four parts of the governance cycle, as well as universal questions and key considerations pertaining to each, are explained here.

Figure 9: Four components to operationalize extreme heat risk governance



6.1. Demand

Governance of extreme heat risk commonly stems from a clearly defined societal issue. Governments and authorities may recognize growing heat risk and/or anticipate an extreme heat crisis as it emerges and as a result, signal demand and initiate planning. Where there is no demand for action, the governance mechanism to coordinate that action may not have sufficient political attention to be sustainable. However, where political attention or statutory, regulatory or fiduciary imperatives exist, and financial resources (domestic or international) have been identified, there is a viable foundation for governing extreme heat risk. Critically, demand often flows from a person or group of people, not from an event (i.e. a heat event may impel demand for action from the public, but the event is not itself a demand).

At the end of the demand component, some form of mandate (legislation, proclamation, ministerial tasking, etc.) emerges.

Governance mechanisms for demand

Usually, the governance mechanisms that drive the identification of demand include:

- Political processes, including election manifestos, campaigning exercises, public inquiries, internal inquiries, parliamentary scrutiny, policymaking, and legislative and budgetary processes and reviews
- Multisectoral, multilevel coordination mechanisms, including policy and regulatory development, commissions and task forces
- Civil society engagement, including public advocacy, media pressure, popular mobilization, direct government advocacy, cultural production and dissemination

Demand and extreme heat

The multisectoral, multi-scalar and multi-temporal nature of extreme heat risk drivers and impacts presents challenges in the Demand component. Heat is a natural and recurring phenomenon, and it may be unclear what constitutes “extreme heat”. Demand is loudest in times of acute crisis (such as acute heatwaves), but effective, long-term solutions (such as heat-adapted construction, design tactics and technologies or coordination mechanisms) are key to managing the risk.

Furthermore, heat is often a silent killer. It often does not produce visible physical damage to infrastructure and attribution as the primary cause can be difficult, for example, with respect to morbidity and mortality.

Those working in governance should recognize and manage these realities. Civic education about the concept of “extreme heat”, for example, can clarify why the issue is both familiar and distinct from what has been done before. Acknowledging that demand is loudest in acute crises, there is still an opportunity to push for long-term change and investment. Lastly, the cross-cutting nature of the issue makes it vital for the demand signal to reach whole-of-society mechanisms, such as heads of government, business and civil society.

6.2. Plan

Responding to demand requires effective planning mechanisms that can produce a range of different outputs to coordinate and articulate the whole-system actions needed. Each setting will have its own existing wider governance and government arrangements, into which extreme heat governance should be integrated. For example, Heat Action Plans (HAPs) – i.e. cross-government plans that are specific to reducing heat risk – have been found to be useful in some jurisdictions and are discussed at length in Tool 3. Nevertheless, other jurisdictions may benefit more by embedding heat planning into sectoral plans, wider disaster risk reduction plans, climate change mitigation and adaptation plans or similar instruments.

Within this diverse landscape, there is a set of common factors for effective planning:

1. Planning instruments must be chosen in a way that maximizes the likelihood of promoting political, bureaucratic and societal action. This means choosing the instrument that is most effective within the wider governance context.
2. Good planning processes should begin with wide stakeholder consultation across sectors and governance levels to ensure that decision makers, in particular, are engaged in the design process and are responsive to real societal need. Good planning should also create buy-in, as a first step to providing a platform for integrated action, once the plan is approved.
3. Plans must set out the wider vision and mission, goals and clear targets, rather than just setting out a series of activities. They should also operate the right incentives to drive change. Activities will only be likely to achieve the desired impact within a framework that explains the desired outcome, results and how they will be achieved.
4. The plan should be associated with a clearly identified budget line or aligned with potential funding mechanisms or investments that provide sufficient resources to relevant stakeholders.
5. Plans generally require the relevant governing agreements to become effective and operational. Depending on the context, these may include legislation, regulation, memoranda of understanding and standard operating procedures to ensure that coordinated action can be taken in line with the strategies.
6. At the end of the planning component, a step is taken to declare the process final (e.g. signing of the plan by a principal officer), and accompanying communications initiated to gain visibility, and enhance accountability and buy-in.

Governance mechanisms for planning

Given the complex nature of extreme heat, planning mechanisms must be integrated across sectors and levels of governance to be effective. Such mechanisms must therefore be spearheaded and convened by leaders with the capacity and authority to bring together multiple sectors and entities across geographic or administrative levels. This could include, for example, a cross-sectoral, multilevel committee convened by the office of the head of government, the ministry of finance, or a regional governor or mayor.

Planning and extreme heat

The multisectoral, multi-scale and multi-temporal nature of extreme heat creates major challenges for planning. Since the challenge is iterative and accelerating over time, typical planning processes that rely on milestones and beginning-middle-end formulations can be inappropriate. Moreover, the diffuse and cross-cutting impacts and responsibility for action make it unclear who to appoint as a primary director of planning. Finally, budgets frequently couch heat within broader categories such as “resilience”, “drought, or “adaptation”, creating a major difficulty in mapping strategy to resources. “Climate budget tagging” or “risk-sensitive budget reviews” are tools that can be used to track expenditure on climate resilience, and potentially heat risk reduction, across sectors.

Those working in extreme heat risk governance can take steps to address these challenges. For example, while the nature of extreme heat as described above is a signature characteristic, many other climate adaptation challenges (such as flooding, desertification and sea-level rise) have similar features, creating opportunities for cross-learning. Second, where there is no obvious primary director of planning, there is an opportunity for appointing the person best suited to the task. Finally, the fact that budgets are difficult to disaggregate from broader resilience challenges may create opportunities for the planning group to make connections across multiple areas of concern, since heat often occurs at the same time and in the same place as several other hazards (e.g. wildfire, poor air quality and social unrest).

6.3. Act

Once societal demand (including political attention and financing) and planning (including strategies and governing arrangements) are both in place, it becomes possible to take action. Effective extreme heat risk governance should incorporate three distinct types of action.

1. First, a set of **iterative processes** that actors and institutions will carry out to manage heat risks. These could include, for example, **scenario building, risk assessment, public communication and other processes** that are necessary to increase resilience and preparedness, as well as to respond to events.
2. Second, a set of reforms to foster the **enabling environment** (planning processes, institutional mandates, budgetary or financing innovations) and **regulatory or legislative changes** (building codes or other standards) that may be required to operationalize plans.
3. Third, the **strategic investments required to build capabilities and an asset base for subsequent deployment**. These could include, for example, the development of data applications, building a skilled workforce or the creation of improved urban infrastructure that is more resilient to heat risk.

At the end of the Act component, some form of signal is sent to indicate that the endpoint has been reached, and it is time to move to the Learn & Improve component.

Governance mechanisms for action

As with planning, governance mechanisms for extreme heat action must be cross-sectoral, multilevel and transdisciplinary if they are to be effective. Based on the principle of agility, governance mechanisms should not only allow for actions that implement agreed strategies and protocols directly, but also for decision makers to be briefed effectively in real time on the basis of new data, evidence and insights. This ensures that appropriate decisions can be taken and acted on over the course of the governance cycle.

In many cases, it may be appropriate for planning and action to be governed by the same committee or mechanism, constituted as an “always-on” standing body, so that action feeds back into modified and improved plans in a constant feedback loop.

Action and extreme heat

Planned actions are also challenged by the multisectoral, multi-scalar and multi-temporal characteristics of extreme heat risk and its impacts. Real-time, disaggregated data, for example, is vital, given the highly localized nature of vulnerability to extreme heat and the major demographic disparities of its impacts. However, these data systems are expensive and time-consuming to establish.

Moreover, depending on geographic distribution, heat can be typically seasonal in nature; the end of the heat season may reduce the perceived value of action, even if the underlying issues remain. Conversely, for tropical regions with limited temperature variations across seasons, chronic exposure – particularly when combined with high humidity – is of great concern. Finally, taking action involves stakeholders from a wide range of perspectives and approaches, from first responders to long-term city planners, implying significant differences in ways of working and the need for transdisciplinary sharing of expertise and innovation.

Those working on extreme heat risk governance may address these challenges in several different ways. While the extensive and granular data needed to track extreme heat is costly upfront, there are significant co-benefits in better understanding the environmental, demographic and economic characteristics of an area and its potential for economic and social development. While the seasonal nature of heat creates a risk of losing momentum, it also provides an opportunity for short-term adjustments and longer-term action, when temperatures are lower. Finally, while there are major differences in short- and long-term action-taking, these differences can also provide a range of perspectives and the ability to share the burden, given the gruelling impacts of action on responders themselves.

6.4. Learn & Improve

Effective extreme heat risk governance requires significant investment in learning and improvement, so that the governance cycle can be self-sustaining, evidence-based and responsive to the changing risk profile. This requires sufficient monitoring and evaluation to learn the lessons of previous strategies and actions, as well as a set of activities that embed the lessons learned from the evaluation in improving performance for the future.

These activities include capturing and sharing good practices, identifying sources of strength and knowledge in affected communities, advocating and communicating about the need for improved heat governance and providing technical support where necessary to ensure that actors and institutions are able to embed learnings in their day-to-day practice.

Effective learning and improvement are dependent on planning processes having already articulated clear targets and how they should be measured. An evaluation of the success or failure of extreme heat interventions must begin by determining what success would have looked like. Evaluating progress is much more straightforward if success is defined in advance, since this allows real-time data-collection processes to be put in place. Not only

does this reduce the cost of evaluation efforts, it also increases the speed at which evaluation can be carried out, allowing more rapid, effective feedback into improved planning and action.

If evaluation of past practice can be channelled effectively through these activities, it should contribute to refining societal and political demand, so that decision-making and budgets are better targeted to the most important risks, and the most effective strategies to combat them. In this way, the governance cycle continues.

The key knowledge gained is passed back to those involved in demand and planning at the end of the Learn & Improve component.

Governance mechanisms for Learn & Improve

Learning and improvement mechanisms must be designed in a way that matches the goals, data availability and available resources of the jurisdiction in question. At times, it may be appropriate to commission external academic exercises to evaluate a programme's impact, including connecting with risk governance approaches for other hazards. This allows co-benefits to be realized and maladaptation avoided. However, it is also crucial that learning and improvement are closely linked to planning and action. Responses to specific heat disasters and long-term heat resilience measures will need to be evaluated on different but overlapping timescales.

Therefore, it may often be appropriate for learning and improvement to be governed by the same committee or mechanism as planning and action, constituted as an "always-on" standing body, so that action feeds back into modified and improved plans in a constant feedback loop.

Learning and extreme heat

Learning and feedback for improvement are also challenged by the multidimensional characteristics of extreme heat risk. The highly localized and contextual nature of extreme heat makes it difficult to share lessons widely. Moreover, the iterative and intensifying nature of extreme heat means an approach that is as much about managing the challenge as solving it. Finally, the impact of governance is complex, diffuse and difficult to measure – especially in areas such as extreme heat, which imply action from nearly all parts of society.

The following may be applicable for those driving integrated heat risk governance to address these challenges:

1. While there are few approaches with universal applicability, some are applicable across comparable contexts – for example, large cities in hot, arid climates may have similar enough features for learning purposes.
2. The fact that the problem is iterative and accelerating creates the opportunity for learning processes to be iterative as well: another heat season is never far away.
3. The frequent, global nature of extreme heat creates the possibility for natural experiments – for example, twin cities across international borders have nearly the same exposure but may take different governance approaches, which can be studied and learned from.

6.5. Data and analytics

Every component of the governance cycle requires effective data and analytics to work well. Demand for change, planning processes, iterative action and learning exercises all need to be informed by three types of information.

- **Accurate, up-to-date data** drawn, for example, from meteorological systems (what is the heat situation?), health systems (how is human health and healthcare delivery, including emergency admissions, being affected by heat?) and from across the various sectors affected (what are the effects on food and energy systems, water resources, urban infrastructure, working conditions for labourers, etc.?) and ecosystems (what are the effects on soils, forests, grasslands, rivers, marine ecosystems, etc.?).
- **Signals drawn from the data.** Heat governance requires effective analytics that can identify and present the important signals within the data that have value for decision-making to decision makers. Such signals could include, for example, nearing or reaching a temperature threshold that has been identified as requiring specific actions, such as closing schools. These signals must be communicated in a way that can be easily understood by busy decision makers who are non-specialists and have limited time and attention for heat within a wide portfolio of risks and challenges that fall within their remit. This has often most effectively been done by data dashboards that are frequently updated and presented on a regular basis within cross-sectoral integrated (plan / act / learn) governance meetings.
- **Insights drawn from the signals.** While signals extracted from data are the first step towards improved decision-making, signals themselves do not always dictate specific action. Unlike the example of a pre-agreed temperature threshold with a clear response protocol, other signals, which are often complex and may have compounding behaviours such as temperature and air pollution, can raise many questions. This is particularly true when resources are limited and trade-offs must be considered.
- The final stage of a data and analytics function that supports extreme heat risk governance effectively is that decision makers can access actionable insights from the signals, based on learning from the past, trade-offs and judgements, and by combining data with voices from the field, including civil society. These insights provide the most value for decision makers. They could include, for example, the data and analytics team identifying that the currently approved budget for urban infrastructure improvements will still leave large areas of a city affected by intolerable heat islands, with potential impacts on both health and societal unrest.

Few jurisdictions claim that accurate, up-to-date data and analytics for decision-making are readily available. Particular challenges include:

- Lack of data sharing across ministries, sectors and functions, within government and between government, the private sector and civil society
- Low granularity of meteorological and health data, including limited insight into the wide variation of temperature and humidity within urban environments
- Difficulty in attributing morbidity and mortality to heat
- Challenges in matching diverse data sets, lack of interoperability standards (e.g. for health, meteorological and utilities data sets), including time-sequencing, and accurate, matchable geographic location limiting rapid, real-time decision-making capabilities
- Lack of ecological and wider environmental data
- Lack of data on vulnerable and at-risk groups
- Differing impacts of heat for different economic sectors
- Lack of data and analytics on 'nexus points' revealing interconnections and interdependencies between drivers and impacts in key sectors, such as heat, agriculture, transportation and health
- Lack of integrated surveillance and monitoring systems that capture long-term and event-based reporting

Closing these data gaps can be expensive. Therefore, stakeholders in each jurisdiction should evaluate their own data and analytics capabilities, and focus on the investments that will produce the most impact for improved

decision-making in their own context. This may require a more pragmatic approach, triangulating available data along with qualitative sources to provide as complete a picture as possible: seeking perfection should not be a barrier to progress.

Governance mechanisms for data and analytics

Where resources allow, data and analytics should be constituted as a well-staffed function that has the authority to collect all relevant data (e.g. anonymized health data from the ministry of health or other data-holding institutions), the resources to improve data-collection methods (e.g. installing heat sensors in the urban environment), quality control capabilities and the skill set to analyse data so that it provides decision-support tools that generate clear insights and signals, and so that these are presented to decision makers and the public in an applicable form.

An analytics function of this kind can form part of a wider team, for example, a disaster risk reduction analytics, climate resilience analytics budgetary review team or the analytics team of the head of government. It is critical that the analytics function is able to produce signals and insights, and that these are incorporated into decision-making at every stage of the governance cycle: when identifying **demand**, when making **plans**, when taking **action**, and when **learning** and **improving**.

Examples of key data and analytics questions related to extreme heat

Hazard forecasting

- How reliable are short-, medium-, and long-term weather forecasting products? How do key tools such as AI and machine learning affect reliability?
- Do the products generate enough granularity to capture, for example, the urban heat island effect?
- Do the forecasting tools account for distinctions between, for example, temperature, humidity and wet-bulb temperature?
- Which kind of extreme heat is most problematic – daily maximum, daily minimum, number of days in a row, number of days per month or year?
- Does the target audience understand these distinctions and their implications?

Exposure

- Which health conditions are aggravated or caused by extreme heat exposure?
- Do sufficient data on the prevalence of these conditions and its associated scale exist?
- Which specific metrics are being used to monitor heat exposure and related health outcomes?
- What is an effective method for understanding the fraction of disease-specific cases, for example, heart attacks attributable to extreme heat?
- How does the epidemiological risk differ across groups and is disaggregation feasible with current data sets?
- What is the geographic distribution of vulnerable groups, critical infrastructure and other assets?
- Does the target audience understand these risks?

Social and economic

- Is sufficient data available about both the burden of heat across economic sectors or professions, and how investment and practices are contributing to driving extreme heat and the burden imposed?
- Is there sufficient data about the demographics of people employed in these sectors or professions affected by extreme heat and whether they have heat-sensitive health conditions?
- Are the economic burdens already quantified at baseline?
- Is there sufficient data for discerning the fraction attributable to extreme heat versus typical seasonal variation?
- Does the target audience understand these indicators?

Demand data

- Are there ways to measure the level of demand, such as public opinion or volume of media coverage, at baseline and over time?
- Are there ways to measure whether the demand signal is specific ("cut deaths from extreme heat by enacting policy X") or non-specific ("do something to stop extreme heat impacts")?

Planning data

- Is there sufficient data about existing action plans, budgets and activities to create an integrated, composite plan across sectors?
- Is the data about key planning metrics, such as head count or agency budget, specific to extreme heat or couched in broader terms such as "resilience"?

Action data

- Are systems in place to track community-level engagement in real time?
- Is there a system to monitor the level of use and engagement of the solutions implemented (e.g. cooling centres)?
- Are the metrics on impacts updated frequently enough to see clear trends?

Learning data

- Is there a natural experiment or other method of comparing the measures implemented with a control group (e.g. a city that has similar features but did not engage in extreme heat risk governance)?
- Are there lessons learned related to the availability of risk, demand, planning or action data that can improve the process moving forward?

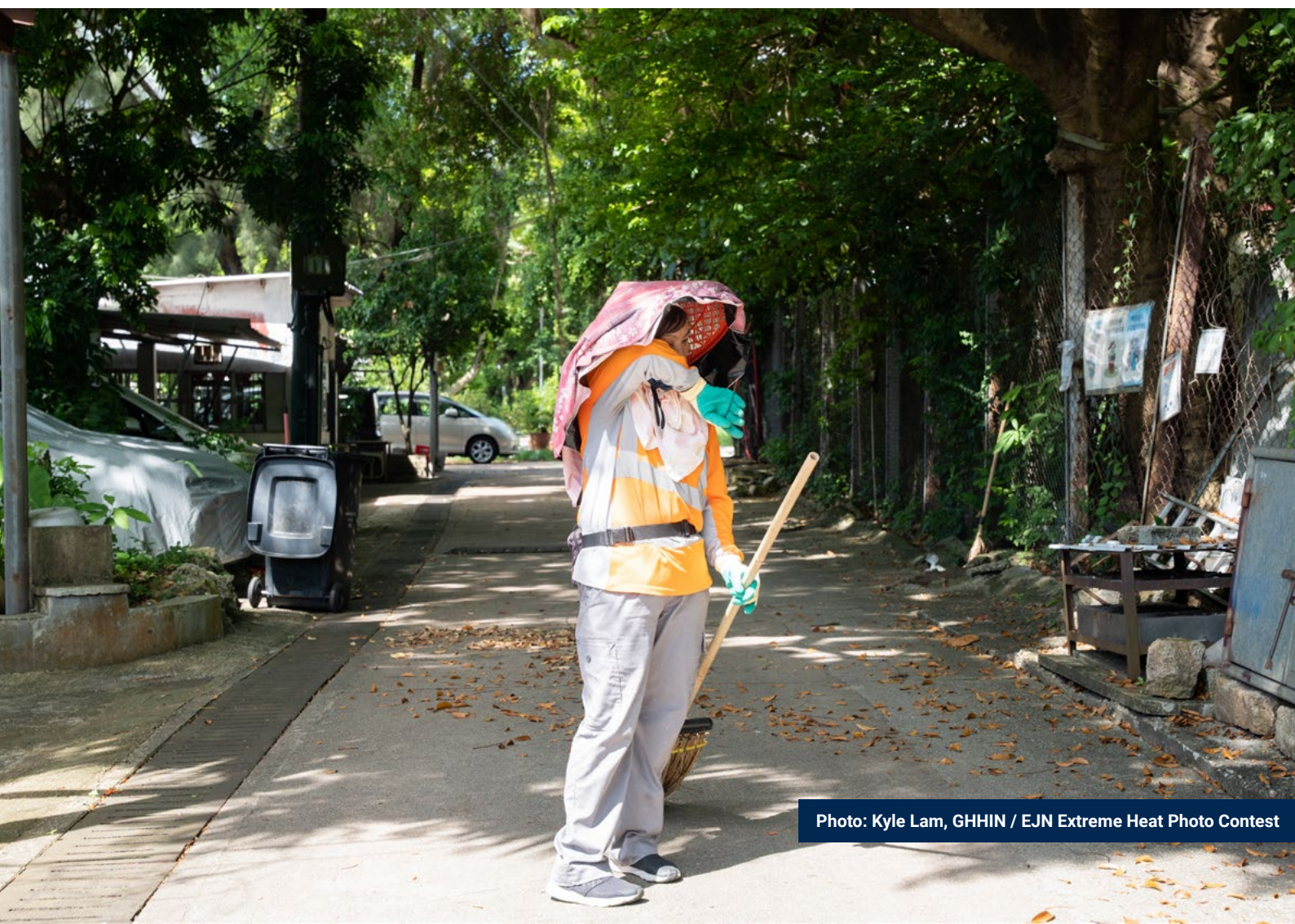


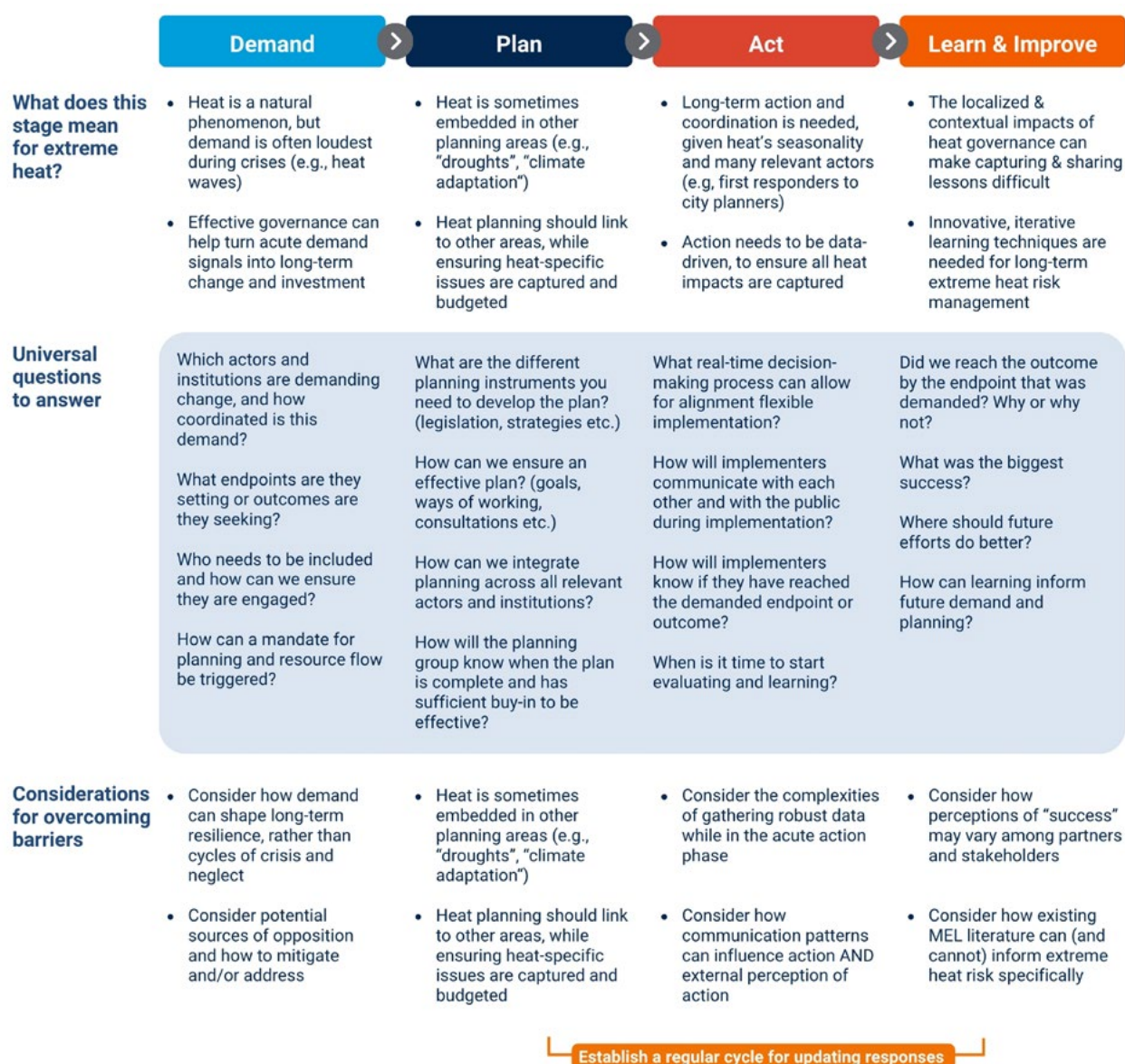
Photo: Kyle Lam, GHHIN / EJN Extreme Heat Photo Contest

6.6. How to operationalize extreme heat risk governance

The framework for managing extreme heat risk is focused on a four-part cycle of demand, planning, action and learning. While each of these components is context-specific and locally grounded, there are a set of universal questions and key considerations that apply in nearly any situation (see Figure 10).

This section sets out what these questions are, identifies the reasoning for their inclusion and suggests possible outputs, as well as factors to consider during this part of the process.

Figure 10: Universal questions across the four components



I. Demand – Sample questions

Regardless of the catalyst, demand for addressing extreme heat risk is **always comes from people**. The goal of this part of the process is to understand the demand signal (legislation, proclamation, tasking, etc.), assess who issued and received it, and determine who needs to be involved in the process as it moves forward.

Universal questions in Demand:

Universal questions (Demand)	Rationale	Output
What actors and institutions are demanding the change? (e.g. head of state, city leader, media, public opinion, etc.) and how coordinated is this demand?	The source, strength and consistency of the demand signal(s) affect what is being asked, who receives the signal, and how they receive it.	Clear identification of the source of the signal with initial analysis of how this might affect next steps.
What endpoints are they setting or outcomes are they seeking? (e.g. the city will halve heat-related deaths by 2030)	Some demand signals are open-ended, but others start with a specific target or end date, with major impacts on the process. Most demand signals set some sort of desired outcome, but the level of granularity varies greatly.	Analysis of whether a target date has been set, a goal number has been identified, etc.
Who needs to be included and how can they be engaged? (e.g. there are 10 key agencies; 5 are at the table but 5 others need to be brought into the group)	Having the full set of actors involved is critical; however, depending on history, context and the nature of the demand signal, they may or may not be part of the group from the beginning.	Map of all necessary and desired potential stakeholders, including who is engaged and who is not, how connected the group is at baseline and preferred tactics for outreach to those not engaged.
How can a mandate for planning and resource flow be triggered? (e.g. is a presidential directive, a declaration of a state of emergency or a piece of legislation needed?)	Resources (including technical assistance) usually flow from a specific event, such as legislation, executive action or judicial orders. Understanding what trigger was used helps guide who is tasked, the availability and source of resources, etc.	Consensus statement on what the triggering event directs and how (if at all) it addresses resource flows.

Key considerations in Demand:

1. Consider how demand can shape long-term resilience rather than solely leading to short-term cycles of crisis and neglect (e.g. a demand signal may arise from an acute emergency but open the policy window for deeper change).
2. Consider potential sources of opposition – political, economic, ideological or institutional – and develop strategies to map resistance, build coalitions, manage trade-offs and ensure equitable solutions, recognizing that opposition patterns differ based on whether demand originates from elites or grassroots.

II. Plan – Sample questions

While no plan is flawless, the process of assembling a plan is critical for securing consensus and building trust among the partners involved in the process. It also serves to clarify how the group will work and to what end. The goal of this component is to make the full set of preparations needed for a robust and timely action component.

Universal questions in Plan:

Universal questions (Plan)	Rationale	Output
What different planning instruments are needed to develop the plan? (e.g., legislation and strategies)	The instrument involved points to the inputs, outputs and process to be followed. (Different instruments require different processes, timelines and stakeholders – selecting the appropriate tool shapes what is possible.)	Selection, with justification, of the best instrument for driving the planning process.
How can we ensure an effective plan? (e.g. goals, planning templates, ways of working and consultation.)	Plans are common, but effective planning means recognizing the group's shared goals, how it will make decisions, who will be consulted and when.	Ways of working list or terms of reference document that defines goals, roles, and processes.
How can we integrate planning across all relevant actors and institutions? (e.g. a unified roadmap)	Integrated approaches imply a "plan of plans" with each actor or institution contributing the results of their own planning process, while retaining autonomy within their respective organizations.	A common template for adding the relevant content into a single "source of truth" document.
How will the planning group know when the plan is complete and has sufficient buy-in to be effective? (i.e. at what point can the plan be made final and approved?)	Understanding when the group has reached its conclusion is crucial but not always clear-cut.	A closing step for the planning documents (e.g. endorsement via group consensus or signature by a leader).

Key considerations in Plan:

1. Consider how to align goals and metrics with what has been demanded, and by when (e.g. if demand signal was for an immediate crisis response, there may be need to foreground goals and metrics that are responsive to the crisis).
2. Consider who has planning expertise, including in areas beyond extreme heat (planners come from many sectors and those who have experience in public health, urban planning, climate-smart agriculture, etc. could have useful bases of knowledge).

III. Act – Sample questions

As with planning, no action component is perfect. However, addressing key issues at the outset reduces the risks of actions that are viewed as disjointed, unclear or adrift. It is critical that data and analytics continues throughout this component, as data generated in the course of taking action provides huge additional value.

Universal questions in Act:

Universal questions (Act)	Rationale	Output
What real-time decision-making processes allow for alignment and flexible implementation? (e.g. is there a need for a focal point or command centre?)	A centrally positioned focal point can address gaps and bottlenecks in an agile manner.	Designation of a focal point and consensus understanding of what they will track.
How will implementers communicate with each other and with the public during implementation? (e.g. weekly reports, daily briefings, etc.)	The form and pattern of communication heavily impact perception – does this seem to be an emergency or a slow-burn issue? A matter for the full community or experts?	Designated focal point or coordination mechanism with clear authority, tracking responsibilities, describing content and reporting to both policymakers and the public through a communications plan.
How will implementers know if they have reached the demanded endpoint or outcome? (e.g. heat wave ends or transitions to the next phase, target met)	This stage requires immense focus from all involved; setting these milestones is crucial for keeping the process agile and iterative.	Consensus statement on the date or conditions for concluding the action component.
When is it time to start evaluating and learning? (i.e. has the action component carried on long enough that sufficient data exists?)	Data collected during action-taking can be high quality if the intention to use it for learning is set from the outset.	Establishment of consensus thresholds for when sufficient data has been collected to commence a learning process.

Key considerations in Act:

1. Consider the complexities of collecting robust data while in an acute action component (e.g. data collection in an emergency context is difficult to prioritize but can create gold standard data sets).
2. Consider how communication patterns, mis- and disinformation can affect action AND perceptions of action (e.g. heavy communication may limit time available for non-communications activities, but lack of communication risks losing public interest).

IV. Learn & improve – Sample questions

As action-taking recedes, public and media attention can wane and policymakers may move on to other critical issues. While the learn and improve component lacks recognition, it is a crucial part of closing loops and making sure the process is sustained and improves in future cycles. This component is especially critical for extreme heat, given the long-term nature of the challenge and the need for policies and programmes to continuously evolve and improve over long-term time frames.

Universal questions in Learn & Improve:

Universal questions (Learn & Improve)	Rationale	Output
Did we reach the outcome by the required endpoint and why or why not? (e.g. target missed due to severe heatwave)	There are multiple reasons for what transpired – some are within control of the group and others are not. Determining what precisely happened is critical.	Evaluation report documenting outcomes achieved, gaps and initial analysis of contributing factors.
What was the biggest success? (e.g. data system was modernized to monitor long-term trends)	It is important that after-action analysis captures gains to benefit future rounds.	List of brief, clear, future-relevant stories or data points.
What should future efforts do better? (e.g. engagement with construction industry failed to yield results)	Failures should be addressed constructively by asking “why” as part of an iterative process to understand the full causal chain, not just the proximate reason.	Set of brief, clear, future-relevant stories or data points.
How can learning inform future demand and planning steps? (e.g., next directive should include infrastructure ministry)	Learning needs to loop back to the origin of the demand and feed into the next round of planning.	Set of concrete recommendations for policymakers and planners.

Key considerations in Learn & Improve:

1. Consider how perceptions of “success” may vary among partners and stakeholders (e.g. political, technical, and grassroots actors may diverge; including multiple perspectives is vital).
2. Consider how existing monitoring, evaluation and learning (MEL) literature might or might not apply to heat risk management specifically (e.g. extensive work has gone into MEL for global health, climate change, community development and agriculture – what is and is not useful for extreme heat?).

Tool 3: Plan for Heat Action

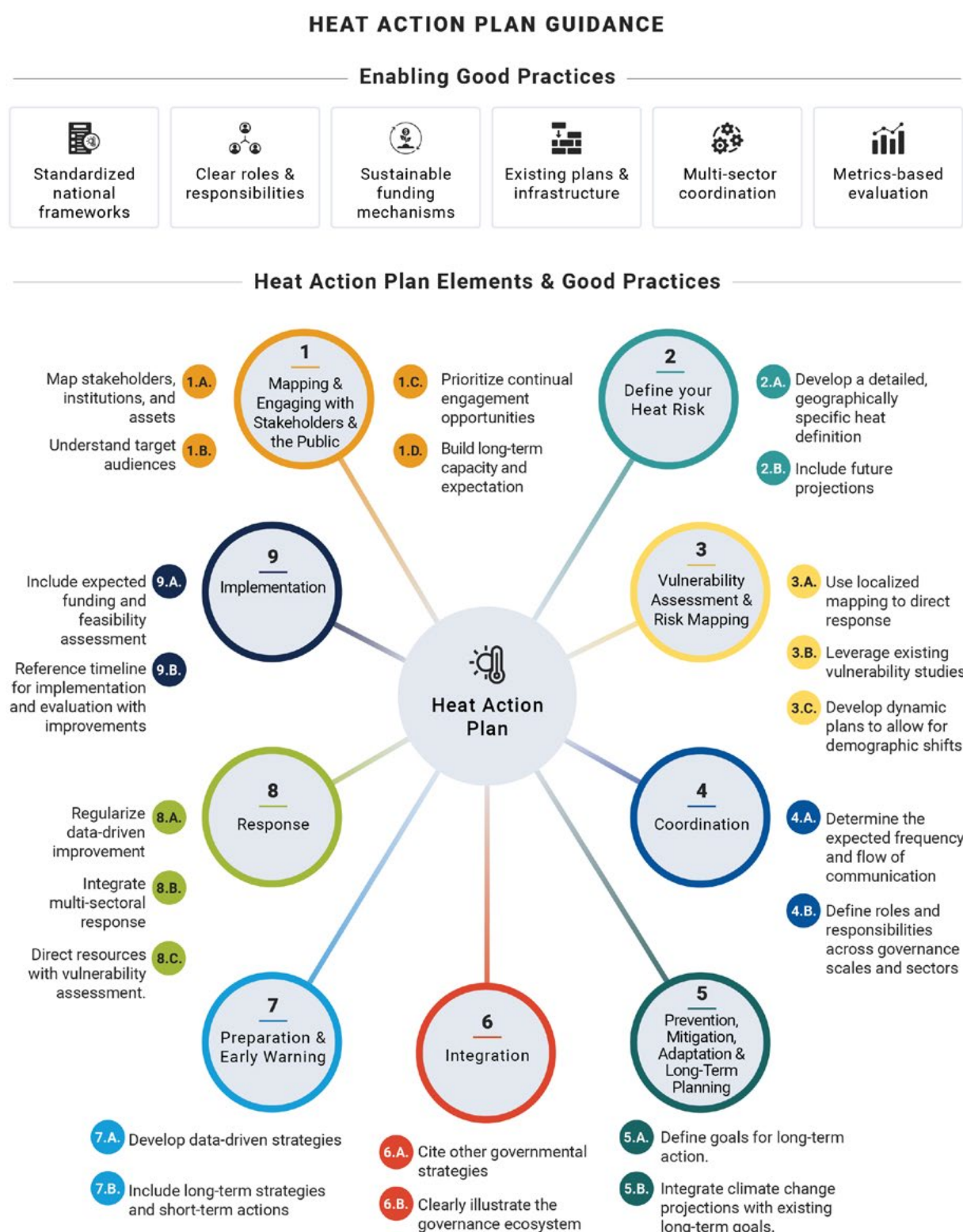
While planning for extreme heat is a vital component of many national climate, disaster risk reduction or public health strategies, Heat Action Plans (HAPs) are important, dedicated outputs that help address extreme heat risk drivers, and prevent and mitigate extreme heat impacts across national, regional and local levels of governance. However, the lack of standards has led to variations in the structure, purpose and implementation of HAPs among nations, regions and municipalities. This variability is often coupled with, and can result in fragmented approaches, leading to critical gaps in funding, vulnerability assessments and long-term resilience strategies.

In 2024, an evaluation of HAPs across six countries – Australia, Canada, France, India, the United Kingdom of Great Britain and Northern Ireland and the United States of America – examined nine essential elements of heat action planning. These included vulnerability assessments, early warning systems and long-term planning to identify best practices and persistent challenges in heat resilience planning. What follows is summary guidance from this analysis. The complete analysis and detailed findings are provided in [“An Assessment of Heat Action Plans: Global standards, good practices and partnerships”](#).

7.1 Heat Action Plan Component Guide

The Heat Action Plan Component Guide (see Figure 11) visualizes nine critical elements of heat action planning and associated recommendations. This practical guide helps planners and policymakers identify strengths and gaps and ensure all essential components are addressed in plan development and updates. The guide's structure facilitates systematic review while maintaining flexibility for context-specific adaptations across different governance levels.

Figure 11: Heat Action Plan Component Guide



7.2 Enabling good governance practices

Six overarching good practices emerged across the HAPs evaluated: **a standardized national framework, clear roles and responsibilities, sustainable funding mechanisms, existing plans and infrastructure, multi-sector coordination, and metrics-based evaluation.** These overarching good practices are applicable beyond each of the nine core elements of a HAP. In particular, as heat response is adopted by agencies included in the HAPs, widespread and integrated campaigns across sectors will be critical to address the complex impacts of extreme heat. Balancing short and long timescales of action will also be key as countries seek to build upon their heat action commitments.

1. Adopt a standardized yet adaptable national framework for HAPs.

A national HAP framework should include a clear structure that can be adapted by local, regional and national governments, ensuring consistency while allowing for local relevance. National guidance can offer a foundational backbone, with key features like clearly defined governance architecture and responsibilities. This adaptable governance framework supports local flexibility and allows subnational plans to align with broader goals, such as heat resilience and emergency preparedness, while remaining contextually relevant.

2. Clearly define roles and responsibilities across levels of government and sectors.

A clear definition of roles, responsibilities and intended audience is crucial for a functional heat action plan. Goals and objectives should be stated upfront, ensuring that all stakeholders across government levels understand their duties in both planning and execution, and have adequate resources (technical, financial, etc.) allocated to support these. A complete action plan must include defined responsibilities, communication channels, time frames and mechanisms for coordination.

3. Embed sustainable funding mechanisms in HAPs.

Addressing heat resilience requires consistent funding for ongoing prevention, mitigation, response and adaptation. HAPs should integrate strategies for fiscal sustainability, and assess and prioritize bankable actions for investment, identifying potential aligned funding sources and conducting feasibility assessments to prioritize high-impact interventions. A HAP (e.g. the city of Tucson, United States of America) that incorporates regular updates and fiscal planning within its adaptive timeline demonstrates a proactive approach to funding, allowing flexibility for evolving climate conditions. Building these elements into HAPs ensures that plans are both actionable and enduring.

4. Leverage existing plans and infrastructure for cost-effective implementation.

A heat action plan can be bolstered by the utilization of existing risk management frameworks and plans such as those for climate adaptation and disaster risk management. Drawing on established vulnerability assessments and existing governance infrastructure ensures that HAPs are both timely and cost-effective.

5. Ensure multisectoral coordination for unified heat risk management.

A multisectoral approach is critical for addressing heat impacts comprehensively. HAPs should connect efforts across health, urban planning, transportation, energy, agriculture, among other sectors, ensuring that heat risk management is unified and inclusive of society-wide needs. It is essential to ensure that single-sector strategies are linked to broader, multisectoral efforts to create a unified response to heat risks across society.

6. Incorporate metrics-based evaluation for continuous improvement.

An effective HAP incorporates metrics-based evaluation, with regular performance reviews that measure the plan's success across its core elements. These evaluations should assess adaptive capacity, response timelines, resource allocation, and community engagement. By integrating evaluation metrics, plans can adapt based on data-driven insights, enhancing their long-term effectiveness. Routine monitoring and updates allow for HAPs to evolve, ensuring that they remain responsive to changing climate impacts.

7.3 Blueprint for effective Heat Action Plans

A strong response to extreme heat requires a structured yet adaptable approach that integrates governance, planning and implementation across multiple sectors, scales and timelines. Good examples exist (see World Health Organization (WHO)) and this blueprint outlines key principles and good practices to help countries develop comprehensive, data-driven and sustainable strategies for reducing and managing heat risks.

1. Mapping and engaging with stakeholders and the public

Standard: Clear understanding of the stakeholder and institutional landscape, followed by active and ongoing engagement with stakeholders and the public, with mechanisms for feedback and adjustments to the plan. Effective engagement is built on a clear understanding of the institutional and stakeholder landscape. Before engaging stakeholders and the public, it is essential to map who is already involved in managing heat risk, what roles they play and which assets and coordination structures are in place. This includes government agencies, health and emergency services, meteorological institutions, civil society and local networks. A solid understanding of this landscape helps ensure that engagement efforts are well targeted and aligned with existing capacities.

Building on this foundation, engagement should be approached as a continuous and adaptive process. Active and ongoing engagement with stakeholders and the public strengthens the effectiveness and legitimacy of heat action plans (HAPs). Continuous dialogue fosters trust, encourages collaboration and ensures that diverse perspectives are incorporated into decision-making. Regular engagement opportunities prevent participation from being a one-time event, allowing for iterative improvements based on real-world feedback. Additionally, building long-term capacity and managing expectations ensures that engagement remains meaningful and sustainable without placing undue burdens on participants. A responsive, inclusive approach enhances both public awareness and the overall resilience of heat adaptation strategies.

Good practices

1.A. Map stakeholders, institutions and assets. Conduct a structured mapping of relevant actors, mandates and existing assets related to heat risk management. This step supports the design of targeted and coordinated engagement strategies and helps identify institutional gaps and overlaps.

1.B. Research and understand target audiences to guide communication and dialogue. Conduct audience research to identify people's information needs, perceptions of heat risk, trusted messengers, and preferred communication channels. Integrating these insights into coordination plans ensures that communication is grounded in evidence and drives behaviour change.

1.C. Prioritize continual two-way engagement opportunities. One-time involvement is not enough to be considered "active and ongoing engagement", thus strategies for ensuring ongoing stakeholder participation, exchange and feedback are required (see for example the [guide on the continuum of community engagement for King County](#), United States of America).

1.D. Build long-term capacity and expectation. Ensuring that engagement does not place undue burden on stakeholders or the public is essential for their involvement, as is building in feedback-based refinements to the HAPs.

2. Define your heat risk

Standard: Comprehensive definition with clear identification of specific vulnerable populations and areas (e.g. urban heat islands and low-income neighbourhoods).

A well-defined heat taxonomy ensures that heat risks are accurately identified and addressed, particularly for the most vulnerable populations and high-risk areas. By establishing clear definitions and geographic contexts, decision makers can design targeted interventions, allocate resources effectively and communicate risks more clearly. Incorporating historic data and future projections further strengthens resilience by anticipating shifts in heat patterns and enabling proactive, long-term planning.

Good practices

2.A. Develop a detailed, geographically specific heat definition. Climatological context for the area covered by the plan should be included for both awareness and to be referenced for targeted actions.

2.B. Include future projections. Consideration of how heat may change across timescales allows for effective long-term planning.

3. Vulnerability assessment and risk mapping

Standard: Comprehensive vulnerability assessment with detailed risk maps guiding resource allocation and interventions.

A comprehensive vulnerability assessment and risk mapping process ensures that heat response efforts are targeted where they are needed most. Localized mapping provides a clear picture of at-risk populations, guiding resource allocation and intervention strategies to maximize impact. Leveraging existing vulnerability studies enhances efficiency by building on prior research, reducing redundancy and promoting governance cohesion. Additionally, integrating demographic shifts into planning helps ensure that response strategies remain relevant and adaptable over time, allowing for proactive adjustments as community needs evolve.

Good practices

3.A. Use localized mapping to direct response. Convey an in-depth understanding of the needs of the population, the economy, energy and transportation systems, utilities and basic service delivery and ensure response efforts are guided by this knowledge.

3.B. Leverage existing vulnerability studies. Utilizing existing work on understanding regional vulnerability saves resources and promotes governance cohesion.

3.C. Develop dynamic plans to allow for changes in demographic balance. Understanding population dynamics and demographic balance at different timescales is key for developing long-term strategies that are feasible and remain so.

4. Coordination

Standard: Clear and effective coordination among agencies, with well-defined public communication strategies and roles for all stakeholders.

Effective coordination ensures that all agencies and stakeholders work together seamlessly, preventing delays, confusion and inefficiencies in heat response efforts. Clearly defined communication strategies establish a reliable flow of information and encourage two-way dialogue between authorities, communities, and partners,, allowing for timely decision-making and inclusive public outreach. Assigning specific roles and responsibilities across governance levels and sectors enhances accountability and reduces duplication of efforts. Strong coordination not only improves emergency response but also strengthens long-term resilience by fostering collaboration and shared ownership of heat action planning.

Good practices

4.A. Determine the expected frequency and flow of communication. Beyond naming agencies and listing tasks, HAPs should explicitly delineate expectations for communication and coordination.

4.B. Define roles and responsibilities across governance scales and sectors. Separate sectors will have numerous actors in each. HAPs should define roles and responsibilities with each sector and outline feasible levels of cooperation between them.

5. Prevention, mitigation, adaptation and long-term planning

Standard: Well-defined long-term prevention, mitigation and adaptation strategies, including urban planning strategies, design guidelines, building codes, infrastructure improvements and alignment with climate change projections.

Long-term prevention, mitigation and adaptation planning is essential for reducing the inexorable rise in heat risk and building resilience to increasing heat risks over time. By defining clear goals, communities can move beyond short-term responses and take proactive steps toward sustainable, structural solutions. Integrating climate change projections ensures that prevention, mitigation and adaptation strategies remain relevant as conditions evolve, preventing outdated or insufficient measures. Coordination across sectors and governance levels fosters collaboration, optimizes resource use, reduces the risk of maladaptation and strengthens the alignment of heat risk reduction with broader climate resilience efforts. A forward-looking approach not only protects communities today but also prepares them for future climate challenges.

Good practices

5.A. Define goals for long-term action. While adaptation can be a less well-defined ambition, utilizing specific goals for long-term action will help to ensure appropriate steps are taken outside of immediate preparation and response.

5.B. Integrate climate change projections with existing long-term goals. Coordinating across sectors and governance levels to unify long-term goals for heat adaptation builds partnerships and preserves resources.

6. Integration

Standard: Comprehensive integration with multiple plans, ensuring a cohesive approach to managing extreme heat across sectors and scales, with robust communication.

Integrated governance ensures that HAPs are aligned with broader policies, maximizing efficiency and effectiveness. By directly referencing other governmental strategies across sectors and scales, HAPs promote policy cohesion, streamline resource allocation and create opportunities for cross-sectoral and multi-scale partnerships. Clearly mapping the governance ecosystem enhances coordination by identifying roles, responsibilities and potential gaps in coverage. A well-integrated approach strengthens communication across agencies and sectors, reducing redundancy and ensuring a comprehensive, unified response to extreme heat challenges.

Good practices

6.A. Cite other governmental strategies. Direct references to other, relevant government strategies builds cohesion across policies while incorporating opportunities for partnership and resource sharing.

6.B. Clearly illustrate the governance ecosystem. Describing the interactions between the levels of heat governance ensures awareness of the position of the HAP and mitigates potential gaps in coverage.

6.C. Establish formal mechanisms for multisectoral, multi-scale cross-agency collaboration. These may include interministerial committees, joint working groups, task forces and shared information platforms, with clear procedures for regular communication, short-, medium- and long-term planning and joint decisions, as well as coordinated responses during heat events.

7. Preparation and early warning

Standard: Detailed and actionable strategies for both short-term and long-term preparedness, including a robust early warning system integrated with communication channels and community outreach, based on health outcome data if available.

Effective preparation and early warning systems save lives by ensuring that communities receive timely, relevant and actionable information about heat risks. Integrating health outcome data enhances the precision of warnings and preparedness strategies, allowing for continuous improvement based on real-world impacts. A balanced approach that includes both immediate actions and long-term strategies ensures that communities are not only ready for the next heat season but are also building resilience against future, intensifying heat risks.

Good practices

7.A. Develop data-driven strategies. HAPs should incorporate data for better more responsive heat strategies. For example, obtaining health outcome data and incorporating it to refine EWS and preparedness actions provides opportunities for objective improvement.

7.B. Include long-term strategies and short-term actions. While preparation for the next heat season will always take precedence, it is also important for HAPs to prioritize actionable steps to achieve long-term preparatory goals.

8. Responses

Standard: Detailed and actionable strategies for both short-term and long-term responses, including continuity from preparedness plans based on health outcome data.

A well-structured response ensures that heat-related risks and emergencies are managed efficiently, minimizing health impacts and disruptions. By incorporating health outcome data, response strategies can be continuously refined to improve effectiveness. Regularizing data-driven improvements strengthens adaptive capacity, ensuring that lessons from each event inform future actions. Multisectoral coordination is critical for a seamless response, reducing gaps and redundancies across agencies and organizations. Additionally, integrating vulnerability assessments and processes to assess interventions (such as cost-benefit analysis) and subsequently prioritize actions that require investment (from public or private financiers, or a combination of both) ensures that resources are directed where they are needed most, prioritizing people, infrastructure, systems and ecologies at the highest risk.

Good practices

8.A. Regularize data-driven improvement. In addition to ensuring that metrics are collected to assess efficacy, response mechanisms should provide routine opportunities for evidence-based refinements.

8.B. Integrate multisectoral response. While governance mechanisms may dictate whether a document is single or multisectoral, response strategies should incorporate cohesion elements to mitigate gaps and overlapping response.

8.C. Evaluate and develop bankable projects and allocate resources strategically for maximum impact. Response plans should incorporate mechanisms that prioritize areas of greatest need, when possible leveraging real-time data, heat exposure patterns, health impact trends, and be steered by economic and financial valuation tools that produce cost-effectiveness indexes to develop investible pipelines of projects that could be successfully funded or financed by public and private financiers. This ensures resources are deployed efficiently, minimizing preventable harm and optimizing the effectiveness of responses.

9. Implementation

Standard: Comprehensive implementation plan with clear timelines, responsibilities and a robust monitoring system to track effectiveness and allow for plan revisions, with clear communication channels.

A well-defined implementation and monitoring plan ensures that heat action strategies translate into tangible, effective outcomes. Clear timelines and assigned responsibilities create accountability and keep efforts on track. Robust monitoring mechanisms allow for continuous assessment, enabling data-driven improvements and necessary plan revisions. Including funding considerations and feasibility assessments helps align expectations with available resources, ensuring that plans are both actionable and sustainable. Transparent evaluation timelines and oversight further enhance effectiveness by fostering accountability and long-term commitment to heat resilience.

Good practices

9.A. Include expected funding and feasibility assessment. Budgetary descriptions are vital for ensuring accurate implementation, as is an understanding of the realistic feasibility of a plan.

9.B. Reference timeline for implementation and evaluation with improvements. Practical execution requires a transparent timetable of action and evaluation, as well as naming supervisory bodies.

Appendices: Learn from others



Photo: Joy Saha, GHHIN / EJN Extreme Heat Photo Contest

Appendix I - Extreme heat risk governance case studies

Introduction

Extreme heat is a growing global threat, putting public health, infrastructure and economies at risk. Countries have developed different strategies to manage these challenges, with varying levels of success.

This section covers a 2024 case study analysis of 13 countries – Argentina, Australia, Bangladesh, Canada, Ecuador, Egypt, France, India, the Republic of Korea, Senegal, Singapore, the United Kingdom of Great Britain and Northern Ireland, and the United States of America – which provides key insights into what works, where gaps remain and how policies can be improved. The following sections provide the detail of the [“Narrative Analysis: Case studies in heat resilience”](#) and offer learnings and practical guidance for strengthening heat governance, improving coordination, closing data gaps, increasing public engagement and fostering innovation. The lessons learned can help governments, organizations and communities build more effective and sustainable heat resilience strategies.

Governance mechanisms

Governance mechanisms for managing extreme heat vary widely and significantly influence the effectiveness of data collection, monitoring and response capabilities. These structures – centralized, decentralized, or mixed – determine the degree of coordination across local, subnational, national and international authorities and shape how effectively strategies integrate across sectors and scales.

Centralized systems provide strong national frameworks that integrate real-time health and meteorological monitoring, ensuring consistent data collection and early warning dissemination. However, their success depends on effective coordination with local and subnational governments for implementation. Decentralized systems delegate responsibility to regional and local authorities, allowing for context-specific adaptation but often resulting in fragmented efforts and inconsistencies in data monitoring, particularly where resources are limited. Mixed governance models combine national frameworks with local flexibility, balancing standardization and adaptability. When well coordinated, these models align national strategies with municipal heat action plans and emergency response systems.

International organizations play a key role in harmonizing efforts across national boundaries, providing technical support, funding, and capacity-building to strengthen local and national initiatives. Heat governance is most effective when these different levels – local, subnational, national and international – are integrated into a cohesive system that ensures both top-down policy direction and bottom-up implementation tailored to community needs.

Coordination across sectors

Effective heat resilience requires a multi-scalar governance approach that connects strategies across health, urban planning, energy, transportation, food and agriculture, emergency management, environmental services and communications, while ensuring alignment between national policies and municipal implementation.

National-level coordination sets overarching policies, establishes funding mechanisms and ensures data standardization. Subnational and municipal authorities implement context-specific interventions, adapting national frameworks to local needs. International cooperation supports knowledge-sharing, resource mobilization and technical assistance to strengthen national and local efforts.

Key mechanisms for coordination include inter-agency committees, task forces and public-private partnerships that provide platforms for cohesive planning and response. Successful heat resilience efforts also require vertical integration, ensuring that national policies trickle down effectively to local levels while allowing for adaptation

based on community-specific challenges. Data-sharing platforms and standard operating procedures facilitate better communication across governance levels. Regular collaborative workshops help align municipal efforts with national strategies and international best practices, creating a more unified response to extreme heat.

Data gaps and impact attribution

Governance models directly influence the efficiency of data collection and impact attribution in managing extreme heat. Centralized systems have the advantage of integrating health surveillance and meteorological data efficiently, enhancing monitoring and early warning capabilities. However, decentralized models, while capable of addressing local conditions, often struggle with inconsistencies due to resource and capacity variations.

A robust, multi-temporal approach to data collection is critical for understanding and addressing heat impacts. Short-term data supports immediate emergency response, helping to identify at-risk populations and mobilize resources. Mid-term data tracks seasonal heat trends, informing adjustments to early warning systems and intervention strategies. Long-term data helps assess policy effectiveness, measure cumulative impacts and guide infrastructure investments for sustained resilience.

International organizations such as the United Nations Development Programme (UNDP) and WMO provide technical assistance to enhance local data systems. However, fragmented data sources and limited integration across sectors remain challenges, complicating comprehensive impact assessments. Strengthening coordination among health, climate and emergency management agencies is essential for improving heat risk evaluations and response planning.

Public awareness and engagement

Engaging the public and vulnerable groups in heat resilience requires long-term educational strategies that extend beyond seasonal awareness campaigns. Effective communication should integrate heat risk awareness into school curricula, teaching young populations about heat risks, safety measures and adaptation strategies. Workforce training programmes can ensure that workers, especially in high-exposure sectors such as agriculture and construction, are equipped with heat-stress management knowledge. Healthcare training can help medical professionals recognize and respond to heat-related illnesses more effectively.

While public health guidance and early warning systems are essential, barriers such as socioeconomic disparities, infrastructure gaps and trust in authorities must be addressed to improve engagement and nurture behavioural change. This requires creating environments and social support structures that enable risk-reducing behaviours and decisions, including through public messaging that is culturally relevant and delivered through trusted community networks. Long-term investment in education and workforce training will help embed heat resilience into societal norms, making adaptation measures more sustainable.

Innovation in heat resilience

Countries are advancing heat resilience through technological, policy and social innovations aimed at building adaptive and integrated frameworks. However, different levels of governance play distinct roles in scaling and implementing these innovations.

National governments lead policy and financing innovations, such as heat insurance programmes and climate resilience funding mechanisms. Cities and municipalities deploy infrastructure-based solutions, including cooling centres, tree-planting initiatives and smart urban planning to mitigate the urban heat island effect. Rural communities benefit from flexible and mobile innovations such as decentralized cooling units, mobile health outreach and targeted heat alerts for remote areas. International organizations contribute by funding research, fostering cross-border collaborations and disseminating best practices.

While technological solutions such as real-time heat monitoring and smart city adaptations improve resilience

in urban areas, rural regions require context-specific innovations that consider access limitations and population distribution. Developing scalable models tailored to different governance levels ensures that heat resilience measures reach all communities.

Sustainability of public-private partnerships

Public-private partnerships (PPPs) are essential for scaling heat resilience efforts but long-term sustainability depends on stable investment strategies rather than short-term funding cycles. Governments could consider integrating PPPs into national and subnational development plans through multi-year investment frameworks, ensuring that funding remains consistent beyond electoral cycles.

Revolving funds can reinvest revenues from heat adaptation projects into future resilience efforts. Performance-based financing, where private-sector contributions are tied to measurable heat resilience outcomes, can further enhance accountability and effectiveness. Successful PPPs rely on strong collaboration between government, the private sector and civil society to ensure that heat resilience measures are equitably distributed and effectively maintained. Countries must prioritize local ownership and institutional capacity-building to reduce dependency on external funding and ensure the longevity of heat adaptation strategies.

Common lessons learned and challenges across case studies

Countries are taking different approaches to managing extreme heat, yet many face similar opportunities and challenges. Successful strategies often rely on strong community engagement, cross-sector coordination, early warning systems and investment in resilient infrastructure. At the same time, gaps in resources, data and governance can limit the effectiveness of these efforts, particularly in vulnerable communities. Recognizing these lessons can help refine policies and programmes, ensuring that heat governance strategies are more effective, inclusive and sustainable.

Common lessons learned

Community engagement is crucial: Successful implementation of heat action plans requires active engagement and participation of local communities. Educating the public about heat risks and involving them in planning and response activities enhances the effectiveness of interventions.

Multisectoral Approach: Addressing extreme heat requires coordinated involvement from multiple sectors, including health, urban planning, agriculture and disaster management. Integrated strategies – such as joint task forces and cross-sector response plans – are essential for building sustainable, wide-reaching resilience to heat.

Importance of early warning systems: Early warning systems play a crucial role in promptly and effectively disseminating heat alerts and advisories. Leveraging technology, such as mobile phones and app-based alerts, expands and strengthens outreach.

Building resilient infrastructure: Investing in heat-resilient infrastructure, such as green spaces, cool roofs and energy-efficient buildings, helps mitigate the impacts of extreme heat. Urban planning must incorporate these elements from the outset.

Strengthening healthcare systems: Enhancing the capacity of healthcare systems to manage heat-related illnesses through training, resource allocation and infrastructure improvements is critical for reducing heat-related morbidity and mortality.

Data collection and research: Continuous data collection, research and analysis are vital for understanding heat patterns, assessing the effectiveness of interventions and refining heat action plans. Collaboration with academic and research institutions can support these efforts.

Public-private partnerships: Leveraging the resources and expertise of the private sector through partnerships can enhance the implementation of heat action plans. These partnerships can provide innovative solutions, funding and technical support.

Policy and regulatory support: Strong policy frameworks and regulatory support are necessary to enforce heat mitigation measures. Policies should incentivize the adoption of heat-resilient practices and ensure compliance across various sectors.

Common challenges

Lack of awareness and education: Many communities are not fully aware of the dangers of extreme heat and the necessary precautions to take, leading to insufficient public response during heatwaves and a lack of planning and resilience measures to combat the long-term impacts of sustained high temperatures.

Resource constraints: Financial and technical limitations often hinder the implementation and sustainability of heat action plans, especially in rural and low-income urban areas, where limited budgets and infrastructure restrict access to resources such as cooling centres, early warnings and public health initiatives.

Data and monitoring limitations: Inadequate meteorological data and monitoring systems make it difficult to accurately predict and respond to extreme heat events. This also affects the ability to issue timely warnings and measure the impact of interventions.

Healthcare system capacity: The healthcare infrastructure is often overwhelmed during heatwaves, lacking sufficient resources, trained personnel and facilities to handle the increased incidence of heat-related illnesses.

Coordination and integration issues: Coordination between different government agencies, local authorities, NGOs and private sector entities is often weak, leading to fragmented efforts and inefficient use of resources.

Urban planning challenges: Rapid urbanization and poor urban planning exacerbate the urban heat island effect, making cities more vulnerable to extreme heat. Integrating heat mitigation measures into existing urban infrastructure is complex and costly.

Rural challenges: Limited infrastructure, inadequate healthcare access and insufficient communication networks in rural areas hinder effective heat response and resilience.

Conclusion

Effective heat governance is essential to managing the growing risks of extreme heat. Heat governance encompasses the institutions, policies and coordination mechanisms that enable governments and stakeholders to anticipate, mitigate and respond to heat hazards. Strong governance mechanisms ensure that extreme heat is not treated as an isolated emergency but as an ongoing climate risk that requires integrated, cross-sectoral solutions.

As the framework and toolkit outlines, successful heat governance is multi-scalar, multisectoral, and multi-temporal, engaging national, subnational and local governments alongside public health agencies, urban planners, emergency managers, labour regulators and private-sector partners. A well-governed heat response includes policies that proactively reduce exposure and susceptibility; investments in early warning systems and adaptive infrastructure; and measures that address long-term resilience rather than solely focusing on short-term crisis response.

However, governance gaps remain significant. Many countries and municipalities lack dedicated leadership structures, formalized coordination across agencies or sustained funding mechanisms to ensure continuity in resilience efforts. Disjointed data systems, fragmented policies and insufficient risk attribution further weaken the ability to plan and implement effective interventions.

To strengthen heat governance, future efforts should focus on:

- **Institutionalizing heat as a governance priority:** Elevating heat as a governance issue requires clearly defined leadership roles, legal mandates and integration into existing risk management, health and infrastructure planning frameworks.
- **Enhancing coordination across scales, sectors, and timeframes:** A whole-of-government approach is necessary to align national policies with subnational and municipal implementation while ensuring collaboration across health, energy, labour, urban planning and disaster risk management sectors. Multi-temporal planning must account for immediate response, seasonal preparedness and long-term adaptation.
- **Improving data interoperability and impact assessment:** Strengthening data-sharing mechanisms across meteorological, health and economic systems will improve risk assessments and response strategies. Standardized data collection frameworks will help governments track progress and refine policies over time.
- **Securing sustainable funding mechanisms:** Long-term financing for heat resilience must be embedded within governance mechanisms, utilizing public-private partnerships, climate mitigation and adaptation funds, and innovative mechanisms such as advanced market commitments for heat resilient technologies or parametric insurance to sustain interventions.

Governments and stakeholders must continue to evolve heat governance frameworks to keep pace with escalating climate risks. The strategies, assessment tools and case studies in this framework and toolkit provide a foundation for strengthening governance mechanisms, improving coordination and ensuring that extreme heat is managed not as a crisis to react to, but as a systemic risk to govern effectively across multiple scales, sectors and time horizons.

Case study methodology

The case studies presented here are based on information provided by country representatives through semi-structured interviews or written surveys focused on four key questions. Representatives were solicited from the [Global Heat Health Information Network](#) (GHHIN) database, which focuses on health and meteorological sectors and may not be fully representative of all relevant sectors and perspectives.

While not comprehensive, these case studies provide insights into country-level actions and challenges in managing extreme heat, complementing the broader data collection efforts led by the [Centre of Excellence for Disaster and Climate Resilience](#) (CoE) with GHHIN and the WHO–WMO Climate and Health Joint Programme. They underscore the importance of coordinated efforts, innovative solutions, and international collaboration in building climate resilience.

Four key questions:

1. What specific initiatives and activities is your country implementing to address the challenges of extreme heat? Please provide details on your country's efforts, such as heat action plans, early warning systems, public health campaigns or any other relevant programmes.
2. Which public agencies or government bodies are responsible for carrying out these extreme heat initiatives and activities? Please list the relevant ministries, departments, local government entities or other public bodies, and briefly describe their roles.
3. Has your country established any partnerships with external organizations to combat extreme heat? If so, please describe these collaborations, including:
 - Partnerships with NGOs or community organizations
 - Public-private partnerships with businesses or industry
 - Collaborations with international organizations or other countries. Please provide specific examples of joint initiatives or programs where possible.

4. What are the key achievements or successes in your country's efforts to manage extreme heat? If available, please highlight any measurable outcomes, such as reductions in heat-related illnesses or mortality, increased public awareness of heat risks, enhanced resilience of vulnerable populations, or implementation of innovative heat management strategies.

The case studies were reviewed based on six key dimensions to initiate an in-depth exploration of the complexities of heat governance. These dimensions include:

- Governance structures
- Coordination across sectors
- Data and impact attribution
- Public awareness and engagement
- Innovation in long-term heat resilience
- Sustainability of public-private partnerships (PPPs)

Representatives were given the opportunity to review the synthesized case studies for clarification and verification, ensuring accuracy and reflecting the most up-to-date information on the complexities of heat governance within their sector.

Case studies in heat resilience

Case study 1: Argentina

Argentina has adopted several governance structures to address the impacts of extreme heat, focusing on integrating efforts into broader climate adaptation and disaster management frameworks. The National Weather Service (SMN) first introduced an [early warning system for extreme heat](#) in Buenos Aires in 2009, which has now expanded to cover 71 meteorological stations for country-wide alerts issued year-round due to changing climate patterns. These alerts are disseminated through various channels, including email systems and media partnerships, ensuring broad coverage across regions.

The Ministry of Health, in collaboration with SMN, leads public health campaigns and has developed a sentinel surveillance system to monitor heat-related morbidity, tracking the health impacts of extreme temperatures across provinces. Argentina also involves provincial and local governments in implementing heat action plans and managing hospital responses during heatwave alerts, with emergency services playing a critical role in the outreach and protection of vulnerable populations. Early warning systems are further integrated into workplace regulations, adapting work hours and hydration protocols during extreme heat events, particularly in sectors like construction and agriculture, where workers are at higher risk. While not formalized, coordination with the energy and agricultural sectors helps manage the impacts of blackouts and other heat-related disruptions.

Public-private partnerships play an increasing role in Argentina's heat resilience efforts, including collaborations with organizations like the Red Cross and professional medical associations to improve emergency care and healthcare system capacity. Partnerships are also emerging in urban planning and energy sectors, including projects to develop green spaces and cool roofs to mitigate the urban heat island effect in low-income areas, such as the [Cool Roofs Initiative](#), which targets temperature reduction in disadvantaged neighbourhoods.

An important actor in these efforts is the [Centre for the Implementation of Public Policies for Equity and Growth](#) (CIPPEC), an independent, non-partisan organization dedicated to policy innovation. Through its "Cities" Programme, CIPPEC conducted [dialogues on urban heat resilience](#) to support climate adaptation at the municipal level and was instrumental in presenting a forthcoming project with Wellcome Trust, which aims to enhance Argentina's heat resilience framework through strengthened municipal engagement.

Argentina's key achievements include expanding the early warning system to cover the entire population, developing the sentinel surveillance project to improve data on heat-related health impacts, and leveraging

international funding for research. Additionally, Argentina's public-private partnerships have enhanced its ability to respond to heat risks, and collaborations with international organizations, such as the United Nations and the World Bank, continue to strengthen the country's capacity to manage extreme heat effectively. Argentina has also begun discussions around integrating heat resilience measures into long-term urban development plans, aiming to create a sustainable framework for heat adaptation in the years to come.

Case study 2: Australia

Australia has implemented a coordinated, multi-tiered approach to managing extreme heat through federal and state-level initiatives. The [Australian Bureau of Meteorology \(BOM\)](#) [launched](#) the [National Heatwave Warning Framework](#) in November 2022, which issues heatwave warnings along with behavioural advice during periods of extreme heat. These warnings are disseminated nationwide through online portals, mobile apps, and media partnerships, supporting the management of critical services and infrastructure while providing targeted advice to vulnerable populations. State and territory government emergency services may also issue heatwave warnings, and health departments, in collaboration with federal health authorities, implement localized heat action plans tailored to regional needs, ensuring that responses to extreme heat are context-specific.

The National Heatwave Warning Framework aligns with the [Australian Warning System](#) (Advice, Watch and Act, Emergency Warning), ensuring a consistent relationship between warnings issued by all three levels of government. This system is designed to reduce the impact of heatwaves not only on health but also on critical infrastructure, ecosystems, and societal functions. The warnings allow for a wide range of preparatory actions as heatwaves intensify, escalating advice from vulnerable individuals to healthy people, and including guidance on protecting infrastructure.

Each state and territory has developed its own heat health plans to address heat risks through prevention, preparedness, response, and recovery strategies. Lead agencies vary by jurisdiction but typically include health departments, emergency services and meteorological bodies. The decentralized approach ensures that state and territory governments can adapt their heat action plans to local conditions while benefiting from federal coordination.

Cross-sectoral collaboration primarily involves the integration of public health, meteorological services, and emergency management. While public-private partnerships have not played a prominent role in Australia's heat resilience efforts, there is ongoing exploration of partnerships to incorporate heat resilience into urban planning and infrastructure projects. Efforts are increasingly focused on integrating Indigenous knowledge into heat resilience strategies, recognizing that Western approaches may not be sufficient and that engagement with Indigenous ways of understanding and managing heat could offer valuable insights.

Key achievements include the nationwide Multi Hazard Early Warning System (MHEWS), an informed heatwave warning system developed by BOM, which provides timely information to both the public and authorities, enabling prompt action. Localized heat action plans have been developed across states and territories, allowing for tailored responses to regional climate conditions and population needs. These efforts have significantly strengthened Australia's resilience to extreme heat and improved cross-sectoral public health response capabilities.

Australia's model of decentralized, state-led heat management supported by strong national coordination highlights the importance of localized adaptation strategies. While public-private partnerships were not prominently featured, Australia's comprehensive warning system and cross-government collaboration provide a robust foundation for responding to extreme heat. This model offers valuable insights for countries with similar governance structures and emphasizes the need for integrating Indigenous knowledge, health, climate, and urban planning efforts to build long-term resilience.

Case study 3: Bangladesh

Bangladesh has adopted various governance structures within its broader climate change adaptation and disaster management frameworks to address extreme heat. Key national policies include the [National Adaptation Plan](#) (NAP 2023-2050), the [Bangladesh Climate Change Strategy and Action Plan](#) (BCCSAP 2009), and the [National Disaster Management Plan](#) (NDMP), [Bangladesh Delta Plan 2100](#), which collectively outline measures for mitigating and adapting to extreme heat.

The [Climate Change and Health Promotion Unit](#) (CCHPU) under the Ministry of Health and Family Welfare has developed a comprehensive climate change and health national adaptation plan (C3HNAP). The [Ministry of Environment, Forest and Climate Change](#), the [Bangladesh Meteorological Department](#) (BMD), and the [Disaster Management Bureau](#) (DMB) play central roles in policy development, early warning systems, and disaster preparedness. Healthcare facilities often lack sufficient resources and trained personnel to handle the increased incidence of heat-related illnesses. A [National Guideline on Heat-Related Illness](#) has been developed with inputs from various experts from government and private healthcare facilities, health departments, and policymakers. The development of this guideline on the management of heat-related illnesses is in line with the goal of achieving Universal Health Coverage through Primary Health Care.

Henceforth, rapid and poor urban planning exacerbates the urban heat island effect, making cities more vulnerable to extreme heat, including the capital Dhaka as one of the most unliveable cities. Big city corporations, local governments, and municipalities have started to implement heat adaptation plans supported by NGOs and community-based programs that raise awareness and build resilience. Public-private partnerships (PPPs) are playing vital roles in addressing extreme heat in Bangladesh. These partnerships focus on enhancing climate resilience through various initiatives, such as collaboration with private real estate developers to create green spaces in urban areas, including parks, rooftop gardens, and green belts, to mitigate the urban heat island effect. One example is the [Cool Roofs Initiative](#), a partnership between the government and local private companies, which implements reflective rooftops in urban slums to reduce indoor temperatures. Initiatives like these enhance Bangladesh's ability to adapt to and mitigate the impacts of extreme heat, contributing significantly to the country's overall climate resilience.

Key achievements include developing [heat action plans](#), enhancing urban planning to reduce heat impacts, conducting public education campaigns, and preparing the health sector to manage heat-related illnesses. Bangladesh also collaborates with international organizations to strengthen its capacity to manage extreme heat effectively.

Case study 4: Canada

Canada has adopted comprehensive governance structures to address extreme heat, involving national strategies, institutional frameworks, provincial and local government initiatives, and public-private partnerships. At the national level, the [National Adaptation Strategy](#) (NAS) outlines objectives and targets to build resilience against extreme heat. The [Health and Wellbeing](#) system in the NAS particularly emphasizes protecting Canadians from climate-related health risks, including extreme heat.

[Health Canada](#) (Government of Canada) plays a pivotal role by providing [evidence-based guidance](#), heat health science, and best practices for provincial/territorial and local authorities to support the development and implementation of [Heat Alert and Response Systems](#) (HARS). It also collaborates with [Environment and Climate Change Canada](#) (ECCC, Government of Canada) to inform the health evidence-informed thresholds used to trigger heat-related weather warnings and the development of heat-health messaging.

Heat action plans in some provinces and municipalities outline specific measures to reduce heat risks, such as establishing cooling centres, disseminating heat health messages, and modifying urban design. Public and private actors play an important role in enhancing heat resilience. In [Toronto](#), efforts have included retrofitting buildings with energy-efficient cooling systems, creating green roofs, and expanding urban parks to mitigate the urban heat island effect. Similarly, [Hydro-Québec](#) collaborates with businesses to promote energy-saving technologies that reduce electricity demand during heatwaves. In [British Columbia](#), the [Interior Health Authority](#) has collaborated

with several Indigenous communities to develop Indigenous-led and culturally relevant HARS.

Key achievements include the widespread implementation of HARS, public education campaigns, and strengthened health sector preparedness to manage heat-related illnesses. Canada also collaborates with international organizations to share best practices, fill knowledge gaps, and advance research, such as addressing indoor heat-health risks. These coordinated efforts aim to protect public health, enhance community resilience, and mitigate the impacts of extreme heat across Canada.

Case study 5: Ecuador

Ecuador has integrated measures to address extreme heat within its broader climate change adaptation and disaster risk management frameworks. Key national strategies include the [National Climate Change Strategy](#) (ENCC), which outlines resilience building across sectors like agriculture, health, and urban planning, and the National Plan for Good Living, which incorporates environmental sustainability and climate resilience. The [National Adaptation Plan](#) (NAP) focuses on adapting to climate change impacts, including extreme weather events like heat waves, by enhancing early warning systems and promoting public awareness.

The [Ministry of Environment, Water, and Ecological Transition](#) (MAATE) leads climate policy development, while the [National Risk and Emergency Management Service](#) (SNGRE) manages disaster risk, including preparedness and response to extreme heat. Local initiatives, especially in cities like Quito and Guayaquil, include municipal climate action plans aimed at mitigating the urban heat island effect through green spaces and improved urban planning. Community-based adaptation programmes, supported by NGOs and international organizations, focus on local resilience through education and infrastructure improvements.

Public-private partnerships (PPPs) do play a role in Ecuador, though perhaps not as robust as in other case study nations. For example, in Guayaquil, the local government partners with construction companies and paint manufacturers to promote the installation of cool roofs in residential and commercial buildings. These roofs use reflective materials to reduce indoor temperatures and energy consumption.

In addition, utility companies in Ecuador, in partnership with local governments and international organizations, promote energy efficiency programmes that help residents and businesses reduce their energy consumption during heatwaves. These programs include incentives for installing energy-efficient cooling systems and improving building insulation. And, the [Ministry of Agriculture](#) works with agribusinesses and NGOs to promote sustainable farming practices that can withstand extreme heat. This includes the development and distribution of heat-resistant crop varieties and the implementation of water-efficient irrigation systems.

Key measures include developing early warning systems, conducting public awareness campaigns, and incorporating green infrastructure in urban planning. The healthcare sector is being strengthened to handle heat-related illnesses through training and improved infrastructure. Ecuador collaborates with international organizations like the UNDP and the World Bank for technical assistance and funding and conducts research to better understand and mitigate the impacts of extreme heat. These integrated efforts aim to build resilience against the impacts of extreme heat in Ecuador.

Case study 6: Egypt

Egypt has implemented various governance structures to address the challenges posed by extreme heat, integrating these efforts into broader climate change adaptation and disaster risk management strategies. The [National Climate Change Strategy](#) and [Egypt Vision 2030](#) outline Egypt's overall approach to enhancing resilience across sectors such as agriculture, health, and urban planning. The [Egyptian Environmental Affairs Agency](#) (EEAA) and the Ministry of Environment lead these efforts, collaborating with other relevant ministries and organizations.

The [National Centre for Disaster Risk Reduction](#) (NCDRR) is expected to play an increasing role in disaster risk management, including extreme heat preparedness, though its involvement in this area is still developing. Local initiatives in cities like Cairo and Alexandria are focused on addressing the urban heat island effect through

increased green spaces, improved urban planning, and public awareness campaigns. However, the scale and impact of these initiatives vary, and they may be more pilot projects than widespread programmes at this stage. Community-based adaptation programmes, supported by NGOs and international organizations, contribute to local resilience through awareness programmes and infrastructure improvements, including cooling centres, health services, and urban greening. However, these initiatives are often localized and vary in scope and effectiveness.

Public-private partnerships (PPPs) are beginning to play a role in enhancing climate resilience, though their scale and impact are still evolving. For example, Cairo has explored smart city technologies to monitor heat, with potential partnerships involving companies like IBM and [Vodafone Egypt](#). These efforts are in the early stages, and their impact is still being assessed.

In Alexandria, there are ongoing discussions about potential collaborations between the Alexandria Health Directorate and private sector entities like [Cleopatra Hospitals Group](#) to improve heat-health preparedness, but these initiatives are not yet fully operational.

Egypt also collaborates with international organizations like the United Nations Development Programme (UNDP) and the World Bank for technical assistance and funding. Ongoing research and data collection by Egyptian institutions, supported by international partners, aims to better understand and mitigate the impacts of extreme heat. These efforts are part of a broader strategy to build resilience against climate-related risks, including extreme heat.

Case study 7: France

France has developed a comprehensive framework to manage extreme heat, significantly reducing heat-related mortality and improving public awareness. The approach includes national, regional, and local initiatives, guided by lessons learned from the 2003 heatwave, which prompted the creation of a robust governance structure to prepare for and respond to heat risks. The [Ministry for Ecological Transition](#) leads national climate change [adaptation efforts](#), while the [Ministry of Health](#) oversees the interministerial system for health management of heatwaves, active annually from June to September. [Météo-France](#) provides weather forecasts and early warnings, while Santé publique France manages health surveillance systems and public health campaigns to raise awareness of heat risks.

Local governments, including departmental prefects and mayors, are responsible for implementing heat management plans, such as ORSEC, [Organisation de la Réponse de Sécurité Civile](#), and communal safeguard plans. These local strategies include access to cooled public places, ensuring access to water, and maintaining registers of vulnerable individuals for targeted interventions.

France's heat response benefits from strong collaboration across sectors. [Electricité de France](#) (EDF) ensures energy supply during heatwaves, coordinating its water intake for cooling purposes with its hydroelectric dams capacity. [Veolia](#) manages water resources. NGOs like the [French Red Cross](#) and [Secours Populaire Français](#) assist local governments by providing services to vulnerable populations. International partnerships with the WHO and participation in EU initiatives like [Horizon 2020](#) also bolster France's heat resilience efforts.

France has achieved a significant reduction in heat-related mortality, with no extreme excess mortality observed during severe heatwaves since 2004. While these events have not matched the severity or duration of the 2003 heatwave, they have still impacted mortality and healthcare services. Public awareness campaigns have also been highly effective, with 75 per cent of the population reporting they are well informed about heat risks. France has implemented innovative strategies, including the creation of cool islands in urban areas and localized heat action plans tailored to regional needs. Through ORSEC and communal safeguard plans, local governments have mobilized resources to protect vulnerable populations, ensuring effective heatwave response.

France's success in managing extreme heat, through national policy and localized action, demonstrates the importance of early warning systems, cross-sectoral collaboration, particularly in water and energy, and strong governance.

Case study 8: India

India has implemented significant governance structures to address extreme heat, with a focus on early warning systems, awareness campaigns, public health management, and adaptation strategies. India's efforts have resulted in a reduction in heat-related illnesses and mortality, particularly in urban areas, where lower-income populations are especially vulnerable. Governance is coordinated at multiple levels, involving national, subnational, and local governments.

The [National Disaster Management Authority](#) (NDMA) plays a central role in setting policies, guidelines, and framework for developing heat action plans (HAPs) and early warning systems, collaborating with state, district, and city-level disaster management authorities. The [India Meteorological Department](#) (IMD) provides a [7-day probabilistic heat early warning system](#), along with seasonal and sub-seasonal forecasts for summer months. These warnings help regions prepare for heatwaves and protect vulnerable populations. The [National Centre for Disease Control](#) (NCDC), under the [Ministry of Health and Family Welfare](#), leads public health surveillance, health sector preparedness and health workforce capacity-building initiatives to manage heat-related illnesses. It conducts community awareness activities through [national](#) and sub-national Heat-Health Action Plans and provides technical guidance under the [National Programme on Climate Change and Human Health](#). State and local governments, particularly in cities like Ahmedabad, implement localized heat action plans tailored to local needs.

India's early warning systems are adapted to the country's diverse climate and linguistic landscape. State-specific approaches, such as translating warnings into local languages, ensure accessibility in urban and rural areas alike. Local governments collaborate with civil society organizations, such as the [Natural Resources Defense Council](#) (NRDC) and the [Indian Institute of Public Health](#), to develop and implement heat action plans in cities like [Ahmedabad](#), Bhubaneswar, and Jodhpur.

India also leverages public-private and nonprofit collaborations. Pilots of parametric heat insurance, targeting vulnerable populations like outdoor women workers in low-income urban and rural areas, have been launched with organizations such as the [Self-Employed Women's Association](#) (SEWA) and [Mahila Housing Trust](#). Although challenges around sustainability remain, these initiatives provide financial protection during extreme heat. Additionally, low-cost passive cooling solutions like the [Cool Roofs Initiative](#), which installs reflective materials on rooftops to reduce indoor temperatures, provide thermal comfort and reduce energy cost for cooling have been piloted in several states.

India has achieved notable successes in heat management, particularly in Ahmedabad, the first city to implement a heat action plan. Ahmedabad's [HAP](#) has significantly reduced heat-related illnesses and mortality and has served as a model for other regions. The scaling of heat action plans across the country has led to more scientific, evidence-based approaches. Early warning systems have expanded to cover more regions since 2015, providing impact-based warnings nationwide. Furthermore, multi-sectoral integration – spanning agriculture, water management, utilities, and transportation – reflects India's comprehensive approach to heat resilience. India's innovative and collaborative efforts position the country as a leader in managing extreme heat. While challenges remain, particularly in ensuring the sustainability of heat insurance programmes and recognizing heat as a formal disaster, India's focus on scaling its initiatives across states and sectors demonstrates its commitment to building robust heat adaptation strategies.

Case study 9: Senegal

Senegal has implemented various initiatives to manage extreme heat as part of its broader climate adaptation strategy. The [National Meteorological Agency](#) (ANACIM) plays a central role in producing heatwave bulletins and forecasts to support local preparedness and adaptation measures. Since 2022, ANACIM has issued 35 heatwave bulletins, helping to inform the public about heat risks and guide preventive actions.

Senegal's approach involves cross-sector coordination, with the meteorological agency working closely with the [Ministry of Health](#), the [Ministry of Environment](#), and civil protection authorities. These collaborations ensure a comprehensive response to heat risks, covering early warnings, public health preparedness, and emergency

response efforts. The Ministry of Health also partners with ANACIM to run awareness campaigns that educate the public on the health risks associated with heatwaves and provide guidelines for protection.

Key initiatives include the regular release of heatwave bulletins developed using local climate data and global climate models. These bulletins allow timely interventions, helping to protect vulnerable populations. Public health campaigns have further strengthened Senegal's ability to reduce the health impacts of extreme heat.

Senegal's efforts are supported by key partnerships with international organizations, including [the US National Oceanic and Atmospheric Administration \(NOAA\)](#), which provides access to global climate models to improve forecasting capabilities. These collaborations enhance Senegal's local climate resilience efforts and allow the country to better predict extreme heat events.

Since the launch of its heatwave management initiatives in 2022, Senegal has issued 35 heatwave bulletins and conducted one [pilot](#) test. In November 2023, a heat early warning was issued through local health network, community radio, and local women organizations, among others. A survey was conducted during the pilot: five students in two different high schools fainted due to extreme heat and many small businesses were closed due to extreme heat. Feedback from the population on the adaptation strategy and its impacts has allowed Senegal to better tailor warnings and advice in the bulletins, significantly improving public awareness and preparedness. Cross-sector collaboration between health, meteorological, and emergency management agencies has been critical to the country's success in managing heat risks and protecting vulnerable populations.

Case study 10: Republic of Korea

The Republic of Korea has developed a comprehensive and multi-tiered approach to managing extreme heat, integrating national policies, institutional frameworks, local government initiatives, and community-based actions. National frameworks such as the Climate Change Adaptation Plan and the Basic Plan for the Promotion of Climate Change Response guide efforts to address extreme heat as part of broader climate resilience strategies. The Korea Meteorological Administration (KMA) plays a key role by issuing heatwave warnings and [impact-based](#) heatwave forecasts, using an updated alert system based on Daily Maximum Perceived Temperature, which takes humidity into account to better reflect health impacts. Additionally, the Korean Disease Control and Prevention Agency (KDCA), alongside the KMA, published the first [Climate Health Impact Assessment Report](#) in March 2022. In this report, published every five years, heat-related deaths and illnesses are identified as key health indicators to be monitored.

Collaboration among key institutions enables a coordinated response to heat risks across sectors – including health, industry, livestock, agriculture, and aquaculture – each managed by distinct governmental bodies, and consolidated [guidelines](#) have been given. Healthcare preparedness has been strengthened with the publication of the Climate Health Impact Assessment Report, which monitors heat-related illnesses and deaths. Hospitals and healthcare centres, particularly those with emergency services, have improved their capacity to manage heat-related conditions. Additionally, the Ministry of the Interior and Safety, Republic of Korea, has [called](#) for meetings with other governmental institutions across different sectors.

Local governments, especially in urban areas like Seoul, lead heat mitigation efforts through urban cooling strategies, public awareness campaigns, and the expansion of green spaces. Initiatives include installing green roofs, promoting public transportation through the [Climate Card](#) programme, and constructing cooling stations in public areas to offer relief from heat.

Public-private partnerships have been instrumental in enhancing the country's resilience to extreme heat. The Seoul Metropolitan Government collaborates with private real estate developers to implement green rooftops across the city, while telecommunications company SK Telecom partners with KMA to send real-time heatwave alerts to millions of subscribers.

Currently, emergency information about heatwaves is being provided through the cell broadcast service in Korea. Hyundai Motor Company collaborates with local governments in urban cooling projects, such as installing cooling stations in public areas. These stations provide cool air and water, offering relief to residents and visitors

during heatwaves. LG Electronics partners with Seoul National University Hospital to develop and distribute advanced cooling technologies for healthcare facilities, ensuring hospitals are equipped with energy-efficient air conditioning systems that improve patient care during extreme heat periods. These examples demonstrate the impact of leveraging resources and expertise to enhance resilience to extreme heat.

On the international stage, the Republic of Korea partners with organizations such as the World Health Organization Asia-Pacific Centre for Environment and Health, the Green Climate Fund, and the International Vaccine Institute – all located in the country – to advance knowledge and technical capacity for climate resilience. These collaborations contribute to their leadership in responding to extreme heat. Through its coordinated approach involving national agencies, local governments, public-private partnerships, and international collaboration, the Republic of Korea has strengthened its ability to manage extreme heat. Key achievements include the updated heatwave alert system, localized urban cooling projects, and strengthened healthcare preparedness, positioning the country as a regional leader in climate adaptation.

Case study 11: Singapore

Singapore has embedded heat resilience within a broader whole-of-government approach to climate adaptation and risk management. The [National Climate Change Secretariat](#) (NCCS), established in 2010 under the Prime Minister's Office, leads the development and implementation of domestic and international climate policies. In 2021, the [Singapore Green Plan 2030](#) set a national target to moderate the urban heat island effect and “keep Singapore cool” as part of broader sustainability goals. Through the Centre for Climate Research Singapore (CCRS) under the Meteorological Service Singapore (MSS), the country has completed three National Climate Change Studies, most recently the [Third National Climate Change Study \(V3\)](#) in 2024, providing downscaled projections on temperature and extreme events to inform planning. Under the Interministerial Committee on Climate Change (IMCCC), a Heat Resilience Working Group was established to strengthen resilience to current and future environmental challenges through heat-related adaptation measures and implementation strategies.

The Ministry of Sustainability and the Environment (MSE), the National Environment Agency (NEA), and the Ministry of Health (MOH) jointly launched a national [Heat Stress Advisory](#) in 2023 to guide the general population engaging in prolonged outdoor activities on heat health protection. To support the operationalisation of this advisory, a nationwide network of Wet Bulb Globe Temperature (WBGT) sensors provides real-time monitoring and public alerts accessible via the [myENV app](#). In parallel, the interagency Mercury Taskforce, led by MSE and NEA, has coordinated 37 public agencies to develop and implement a national heatwave plan that enables a coordinated response during heat events, with tailored measures for residents, schools, eldercare facilities and hospitals, sports facilities, uniformed services, and outdoor workers.

Protection from exertional heat stress in the workplace and in sporting activities is a core pillar of this effort. The Workplace Safety and Health Council first issued [Workplace Safety and Health Guidelines](#) in 2010, with revisions in 2012 and 2020, and the Ministry of Manpower (MOM) introduced [enhanced measures](#) in 2023 to further reduce heat stress among outdoor workers. The enhanced measures focus on four protective measures of acclimatize, drink, rest and shade. Separately, Sport Singapore also developed a comprehensive framework to better prepare the sporting community and protect from heat-related injuries through the [Heat Stress Management Plan](#).

Singapore's strategy is anchored in strengthening the scientific basis for heat resilience. Beyond the National Climate Change Studies, dedicated climate impact science research programmes have been initiated to deepen understanding of rising temperature and their implications. Complementing these national efforts, domain-focused research led by the Heat Resilience & Performance Centre (HRPC) and Human Potential Translational Research Programme (HPTRP) at the Yong Loo Lin School of Medicine, National University of Singapore, advances applied knowledge on thermal stress and human adaptation, with a core emphasis on protecting at-risk populations. The research-to-policy approach has directly informed policies as demonstrated through [Project HeatSafe](#), which contributed to shaping MOM's enhanced measures for outdoor workers. HRPC also translates evidence into practice through contributions to Sport Singapore's Heat Stress Management Plan and strengthens regional knowledge exchange as the secretariat for the first regional [Southeast Asia Hub](#) of the Global Heat Health Information Network. These efforts bolster operational readiness, public awareness, and the uptake of evidence-based cooling and risk-reduction practices across society.

Singapore's proactive, anticipatory approach is reflected in the Whole-of-Government integrated strategy for heat resilience complemented by partnerships with businesses, academia, and community stakeholders to manage both acute and chronic heat risks and to build long-term resilience across sectors and communities.

Case study 12: United Kingdom of Great Britain and Northern Ireland

The United Kingdom, through the collaborative efforts of the [UK Health Security Agency](#) (UKHSA) and the [Met Office](#), has developed comprehensive strategies for managing extreme heat. In England – one of the four nations of the UK – the [Adverse Weather and Health Plan](#) (AWHP) defines and guides planning and response efforts related to the health impacts of extreme heat and other adverse weather. The AWHP outlines a common framework for responding to adverse weather, including periods of high temperature, and defines the roles and responsibilities of the different delivery groups at the local, regional, and national levels. The AWHP is underpinned by four core pillars: the Plan itself, guidance, the supporting evidence base, and the Weather-Health Alerting system. Other UK nations, such as Scotland ([Public Health Scotland](#)), have recently published their own [AWHP](#).

In England, two early warning systems operate to address the diverse impacts of extreme temperatures. The [Heat-Health Alerts](#) (HHA), part of the [Weather-Health Alerting system](#), are issued by UKHSA and the Met Office for England to protect vulnerable populations and health and social care services with yellow, amber, and red alerts. The [National Severe Weather Warning System](#) (NSWWS), managed by the Met Office across the UK, issues Amber and Red alerts for broader public impacts in addition to health, including effects on sectors like transport and utilities. These systems are coordinated to ensure consistent public messaging, aligning HHA and NSWWS warnings when necessary for clear, authoritative communication on heat risks.

Public health campaigns play an integral role in the UK's strategy. The UKHSA's "[Beat the Heat](#)" and the Met Office's "[Weather Ready](#)" campaigns provide practical advice on how to stay cool during hot weather, with materials distributed to the public, particularly targeting high-risk groups. UKHSA and the Met Office, in collaboration with various partners, lead these awareness efforts across multiple communication platforms.

UKHSA coordinates with the Met Office, local governments, and emergency services to ensure a comprehensive national response to extreme heat. Local and national authorities are tasked with implementing action plans and providing critical services during extreme heat events.

The UK engages in partnerships with academic institutions, community organizations, and the private sector to bolster heat resilience. Public-private partnerships, particularly with utilities and infrastructure sectors, focus on energy efficiency and public health protection during extreme heat events.

The UK has seen measurable success in managing extreme heat, as evidenced by the response to the record-breaking 2022 heatwave. Despite the extreme conditions, over 1,000 fewer heat-related deaths occurred than historically expected for such record-breaking temperatures. After the event, a Met Office survey revealed that 98 per cent of the public took some form of action in response to issued alerts and warnings during the record-breaking heat period. UKHSA's and Met Office initiatives, including early warnings and public health interventions, contributed to reducing heat-related illnesses and fatalities. The increased public awareness and improved coordination between health services and local authorities highlight the effectiveness of the planning and early warning systems.

Case study 13: United States of America

Recognizing the rapidly growing impacts of increased heat and the lack of a cohesive approach, the United States has begun developing and adopting comprehensive governance structures to address extreme heat at the federal, state and local levels. At the federal level, the [National Integrated Heat Health Information System](#) (NIHHIS) is a formal interagency structure with over 25 Federal agencies and departments actively engaged, and recently released the [National Heat Strategy](#) that covers all time scales from response to resilience. Launched by the [National Oceanic and Atmospheric Administration](#) (NOAA) and the [Centers for Disease Control and Prevention](#) (CDC) in 2015, NIHHIS co-chairs also now include the Health and Human Services (HHS) and the [Federal Emergency Management Agency \(FEMA\)](#).

The mission of NIHHIS is to reduce heat-related impacts by building a societal understanding of heat risks, developing science-based solutions, and improving capacity, communications, and decision-making to ensure a thriving, heat-resilient nation. NIHHIS is where the U.S. Government coordinates and plans heat-related work, [heat.gov](#) serves as the federal entry point for heat-related resources.

The [U.S. Global Change Research Program](#) (USGCRP) also manages a National Climate Assessment (NCA) that summarizes the impact of climate change on the U.S. and includes chapters specific to extreme heat. As an innovative approach to improve heat governance, NIHHIS and NOAA collaborate with local governments and community-based organizations to host tabletop exercises that test and evaluate heat response efforts. These exercises bring together leaders from various sectors, including health departments and emergency management, to identify and refine strategies for enhancing heat resilience in their communities. This proactive, hands-on approach allows participants to simulate heat emergencies and collaboratively develop effective response plans tailored to local needs.

States like California, Arizona, New York, and North Carolina have developed specific heat action plans, and cities such as New York City (NYC), Los Angeles, Miami, and Phoenix have implemented heat response and resilience programmes focusing on public awareness, emergency response, and urban design modifications.

Public-private partnerships (PPPs) are integral to these efforts, with initiatives like Cool Neighborhoods NYC and Phoenix's [HeatReady Initiative](#) collaborating with private organizations, nonprofits, and academic institutions to enhance heat resilience. For example, the City of New York collaborates with private organizations and community groups through the [Cool Neighborhoods NYC](#) program. This initiative focuses on increasing tree canopies, installing cool roofs, and educating residents about heat risks. Private companies contribute funding, technology, and expertise to support these efforts. [Kaiser Permanente](#), a major healthcare provider, also works with local health departments and nonprofits to support community health initiatives addressing extreme heat. They fund programmes that provide cooling centres, hydration stations, and public education on heat-related health risks.

Key measures include the [heat.gov](#) website (which includes the [Heat Health Index](#) and the [HeatRisk tool](#)), the [NWS Heat Forecast Tools](#), the Heat urban planning initiatives, public awareness campaigns, and the establishment of cooling centres and hydration stations. Additionally, NOAA and NIHHIS have published a "[Maturity Model for Heat Governance](#)" that allows leaders and decision-makers to examine their capacity to successfully manage heat risk. In 2024, NOAA and NIHHIS also funded two virtual centres of excellence to support community heat monitoring and resilience. The [Center for Collaborative Heat Monitoring](#) assists communities in conducting local climate and health studies, and the [Center for Heat Resilient Communities](#) supports heat risk reduction decision-making through applied climate and health research and analysis. Finally, ongoing research and data collection by federal agencies, academic institutions, and private organizations help refine adaptation strategies, while international collaboration ensures the sharing of best practices. These coordinated efforts protect public health, enhance urban resilience, and mitigate the impacts of extreme heat across the United States.

Appendix II - External Resources

This section contains useful external resources on extreme heat, across key sectors such as economy, infrastructure, social protection and others. It is not intended as an exhaustive repository, and will continue to be populated in subsequent iterations. Resources cover learnings and guidance on governing extreme heat risk and building resilience, including technical guidelines, articles, proposals, and additional case studies.

Subscribe to [GHHIN's Global Heat Health Digest](#) for new tools, resources and research monthly, and [PreventionWeb newsletters](#) for the latest updates from the DRR community.

1. Cooling

Relevant sectors: Business, labour unions, health, civic organizations

- [Global Cooling Pledge](#) (UNEP)
- [Global Cooling Watch 2023](#) (UNEP)
- [Cooling the world without heating the planet](#) (Oxford Martin School)
- [Beating the Heat: A Sustainable Cooling Handbook for Cities](#) (UNEP)
- [Understanding systemic cooling poverty](#) (Nature Sustainability)

2. Economy and the world of work

Relevant sectors: Business, agriculture, labour, construction, meteorology

- [Technical Guidelines on Managing Heat Stress at Work](#) (Dubai Municipality Health and Safety Department, 2019) (United Arab Emirates)
- [Preventing Effects of Working in High Temperatures](#) (National Council for Occupational Safety and Health, 2024) (Saudi Arabia)
- [Enhanced Measures to Reduce Heat Stress for Outdoor Workers](#) (Ministry of Manpower, Singapore, 2023) (Singapore)
- [Occupational heat stress intervention to prevent Chronic Kidney Disease of undetermined causes \(CKDnT\) among sugarcane workers in Nicaragua](#) (La Isla Network, 2023) (Nicaragua)
- [Impacts of Extreme Heat on Agriculture](#) (Autumn Burton, 2025) (United States of America)
- [Heat at work: Implications for safety and health](#) (ILO, 2024)
- [Climate Change and Workplace Heat Stress: Technical Report and Guidance](#) (WHO and WMO, 2025)
- [Climate Resilience for Frontline Clinics Toolkit](#) (Harvard T.H.Chan School of Public Health C-CHANGE & Americares, 2024)

3. Ecosystems

Relevant sectors: Environmental management, fisheries, forestry, water resources, policy planning, climate modelling

- [Marine heatwaves threaten global biodiversity and the provision of ecosystem services](#) (Dan A. Smale and others, 2019) (Global)
- [Intensified future heat extremes linked with increasing ecosystem water limitation](#) (Jasper M.C. Denissen and others, 2024) (South America, Eurasia, Canada)
- [Extreme heat & drought simultaneous risk assessment](#) (Laura Niggli and others, 2022) (Europe)

4. Events

- [Summary Report: Southeast Asia Heat Health Forum 2025](#) (GHHIN SEA Hub, 2025)
- [Heat Health Open Forum](#) (GHHIN, 2023)
- [First Global Forum on Heat and Health](#) (GHHIN, 2018)
- [Understanding, Modelling and Mitigating Urban Heat Islands](#) (GHHIN Masterclass)
- [Setting Operational Thresholds for Heat Early Warning Systems](#) (GHHIN Masterclass)
- [Innovating in Urban Planning and Governance for Heat Health](#) (GHHIN Masterclass)
- [Economic Valuation of Heat-Health Impacts and Interventions](#) (GHHIN Masterclass)
- [Developing an Effective Heat Health Action Plan for your City](#) (GHHIN Masterclass)
- [Too Hot To Work: Progress and Challenges in Heat Legislation for Worker Protection](#) (Webinar)
- [Heat in the Workplace](#) (Dialogue)
- [Heat in the City](#) (Dialogue)

5. Finance

Relevant sectors: Business, finance, development agencies, multilateral banks

- [Extreme heat and schooling: Proposal for financing strategies to protect learning and safeguard children's future](#) (Inter-American Development Bank) (Brazil)
- [Call for Proposals of the Climate Action Window](#) (African Development Bank)
- [Global Assessment Report on DRR 2025](#) (UNDRR, 2025) (Global)

6. Governance

- [UNSG Call to Action on Extreme Heat, 2024](#)
- [Stocktake Report: Heat action across United Nations Entities and International Organizations](#). GHHIN, UNDRR, WMO 2025
- [An Assessment of Heat Action Plans: Global standards, good practices and partnerships, 2025](#)
- [Supporting Extreme Heat Risk Governance Initiative](#) (GHHIN)
- [UNDRR Heat Action Profile, 2025](#)
- [WMO Heat Action Profile, 2025](#)
- [WHO Heat Action Profile, 2025](#)
- [ILO Heat Action Profile, 2025](#)
- [UNICEF Heat Action Profile, 2025](#)
- [IFRC – Red Cross Climate Centre Heat Action Profile, 2025](#)
- [FAO Heat Action Profile, 2025](#)
- [UNDP Heat Action Profile, 2025](#)
- [OCHA Heat Action Profile, 2025](#)
- [UNU Heat Action Profile, 2025](#)
- [WFP Heat Action Profile, 2025](#)
- [IOM Heat Action Profile, 2025](#)
- [GEO Heat Action Profile, 2025](#)
- [UNHCR Heat Action Profile, 2025](#)
- [UNESCO Heat Action Profile, 2025](#)
- [UNEP Heat Action Profile, 2025](#)
- [UN-Habitat Heat Action Profile, 2025](#)
- [Exploring heat risk adaptation governance: A case study of the UK, 2024](#)
- [Is India Ready for a Warming World? How Heat Resilience Measures Are Being Implemented for 11% of India's Urban Population in Some of Its Most At-Risk Cities](#) (Sustainable Futures Collaborative)

7. Health

- [Heat Health Glossary](#) (GHHIN)
- [Protecting Health from Hot Weather during the COVID-19 Pandemic](#) (GHHIN, 2020)
- [Lancet Countdown Heat and Health Portal](#)
- [Climate Change and Health: Strategic Framework 2025](#) (Africa CDC)
- [Extreme heat and human health: For pharmacists and pharmacist technicians](#) (Health Canada, 2024)
- [Acute Care During Extreme Heat: Recommendations and Information for Health Care Workers](#) (Health Canada, 2024)
- [Climate-Driven Extreme Weather Events: Australian Nurses' and Midwives' Experiences](#) (Planetary Health Collaborative, 2024)
- [Heat-Health Action Plans. Guidance](#) (WHO Regional Office for Europe, 2008)
- [Heat and health in the WHO European Region: updated evidence for effective prevention](#) (WHO, 2021)

8. Humanitarian and development contexts

- [Heat Stress Guidance](#) (Humanitarian Library, 2025)
- [Extreme Heat: Preparing for Heatwaves of the Future](#) (OCHA/IFRC, 2022)
- [Case Study: Anticipatory Action to Reduce the Impact of Extreme Weather Events on Health](#) (USAID, IFRC, 2024)
- [Heat as a Humanitarian Crisis: Local Actions, Global Lessons](#) (Global Shelter Cluster / Extreme Heat Working Group, 2025)
- [Global Shelter Cluster Statement on Extreme Heat and Governance Gaps in Humanitarian Contexts](#) (Global Shelter Cluster, 2025)
- [Lessons for Humanitarian Responders: Heatwaves](#) (ALNAP, no date)
- [Dignity in the Heat: Addressing Health and Shelter Needs in Humanitarian Crises](#) (InterAction, 2024)

9. Infrastructure

Relevant sectors: Business, energy, transport, water, climate modelling

- [Estimating the Environmental Impact of Green Roofs](#) (US EPA, 2018) (United States of America)
- [Implementing nature-based solutions through multi-sector, multi-organisation collaboration to enhance urban resilience to climate change in Malaysia](#) (Adaptation Fund, 2023) (Malaysia)
- [Combating the heat island effect and poor air quality with green ventilation corridors](#) (European Climate and Health Observatory, 2014) (Germany)
- [Berlin Biotope Area Factor – Implementation of guidelines helping to control temperature and runoff](#) (European Climate and Health Observatory, 2020) (Germany)
- [Climate Adapted People Shelters in Australia](#) (Penrith City Council, 2018) (Australia)
- [Where Do We Need Shade? Mapping Urban Heat Islands in Richmond, Virginia](#) (U.S Climate Resilience Toolkit, no date) (United States of America)
- [Cincinnati's Urban Canopy Policy](#) (Urban Land Institute, 2019) (United States of America)
- [Cool Surfaces: Roofs and Roads](#) (Urban Land Institute, 2019) (United States of America)
- [Extreme weather events on energy systems: a comprehensive review on impacts, mitigation, and adaptation measures](#) (Ana C.R. Gonçalves and others, 2024) (Global)
- [Resilience Analysis and Cascading Failure Modeling of Power Systems under Extreme Temperatures](#) (Seyyed Rashid Khazeiynasab and Junjian Qi, 2020) (Global)
- [Extreme Climate Events and Energy Market Vulnerability: A Systematic Global Review](#) (César Dubbier Castro Hernandez and others, 2025) (Global)
- [Impact of Cold Waves and Heat Waves on the Energy Production Sector](#) (Juan A. Añel and others, 2017) (Global)
- [Increased risk of extreme heat to European roads and railways with global warming](#) (Eamonn Mulholland, 2021) (Europe)
- [Weather, climate change, and transport: a review](#) (Stefan Gössling and others, 2023) (Global)

10. Media and communications

- [Reporting on Extreme Heat and Health. Guidance for Journalists](#) (GHHIN, no date)
- [Guía práctica de comunicación. Salud y Calor / Practical Guide for Communication. Health and Heat](#) (in Spanish) (Observatorio de Salud y Cambio Climático, Gobierno de España, 2025)
- [Visualising the heat crisis: A guide for nonprofits](#) (India Development Review)
- [Disaster Risk Communication Hub](#) (UNDRR)
- [Guide for Essential Research](#) (BBC Media Action)

11. Planning

Relevant sectors: Urban planning, rural development, policy planning, climate modelling

- [Sustainable Energy Access and Climate Action Plans](#) (The Covenant of Mayors in Sub-Saharan Africa, 2022) (Cameroon)
- [Keeping Metro Boston Cool: A Regional Heat Preparedness and Adaptation Plan](#) (Metro Mayors Climate Taskforce & Metropolitan Area Planning Council, 2022) (United States of America)
- [Modelling risks due to urban transformation and climate change scenarios](#) (IDAlert, 2023) (Netherlands)
- [How does perceived heat stress differ between urban forms and human vulnerability profiles? Case study Berlin](#) (Nimra Iqbal and others, 2025) (Berlin, Germany)
- [Planning for Cooler Cities: A Multimodal AI Framework for Predicting and Mitigating Urban Heat Stress through Urban Landscape Transformation](#) (Shengao Yi and others, 2025) (Global & Philadelphia, United States of America)
- [Handbook on Urban Heat Management in the Global South](#) (World Bank, 2025) (Global South)
- [Planning for Urban Heat Resilience](#) (American Planning Association, 2022)
- [Plan Quality Evaluation for Heat Resilience](#) (Roy Malini and others, 2025)
- [Plan Integration for Resilience Scorecard™ \(PIRS™\) for Heat: Spatially evaluating networks of plans to mitigate heat](#) (Ladd Keith and others, 2023)
- [Heat Action Platform](#) (Atlantic Council Climate Resilience Center)
- [Fundamentals for Thermal Comfort and Safety: Designing Climate-Ready Playgrounds](#) (Heather M. Olsen, 2025)
- [Informing decision-making about indoor heat risks to human health. Project Brief](#) (GHHIN, WHO, Health Canada, 2022)
- [Guidelines for Cooling Centers](#) (National Disaster Management Authority, Government of India, 2025)

12. Social protection

Relevant sectors: Health, education, safety net organizations, civic organizations, meteorology

- [State Emergency Management Plan Heat Sub-Plan](#) (Emergency Management Victoria, 2022) (Australia)
- [Women climate champions fighting heatwaves and reshaping the urban climate agenda](#) (Mahila Housing Trust (MHT, 2023) (India)
- [Social vulnerability to heatwaves – from assessment to implementation of adaptation measures in Košice and Trnava, Slovakia](#) (European Climate and Health Observatory, 2018) (Slovakia)
- [Heat acclimatization and vulnerabilities of people living in the Sahel: The case of Senegal](#) (Richard Lalou and others, 2018) (Senegal)
- [Explaining differential vulnerability to climate change: A social science review](#) (Kimberley Thomas and others, 2018)

13. Sport

- [Manage and Adapt to Heat in Sports](#) (GHHIN, no date)
- [Extreme Heat and Response Guidelines](#) (Sports Medicine Australia, 2025)

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EXTREME **HEAT** RISK GOVERNANCE

FRAMEWORK AND TOOLKIT



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