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Technologies



Climate risk as workforce risk

The Adecco Group & CLIMADA Technologies

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Executive summary

Climate-risk frameworks often ask whether buildings, infrastructure and financial assets can withstand a changing climate. What is less visible is whether people can continue to work safely, reach their workplace and keep operations running as disruption increases. This is the blind spot this paper addresses: climate risk is workforce risk. Rising heat, heavy rainfall and storms already affect these conditions and are expected to increase in impact, while adaptation measures such as cooling and remote work depend in turn on power, infrastructure and specialized workers. Over longer time horizons, climate-related migration and displacement may also reshape where workers and skills are available.

Our analysis combines forward-looking climate modeling from CLIMADA Technologies with the Adecco Group's labor-market perspective, using scenarios from three business districts - Barcelona's 22@ Poblenou, Houston's Energy Corridor District and Singapore's one-north - to illustrate how climate hazards translate into workforce risks.

The comparison shows: the same physical hazard can translate into very different workforce risks depending on who does the work, where it is performed and which systems workers depend on. Singapore faces the highest heat-related loss of potential working time and the greatest pressure on cooling systems, making reliable cooling, ventilation and specialist building systems particularly important. Houston combines heat exposure with heavy rainfall and storm-related disruption, bringing access to work, household power and recovery skills into focus. Barcelona starts from a lower baseline, but the rapid increase in heat and cooling pressure points to an emerging adaptation challenge for buildings, workplace practices and more exposed support roles.

Across the three locations, our analysis points to four key workforce implications:

- 1. Protect exposed and operationally critical workers.** Average workforce exposure can hide the people most at risk. Physically demanding roles are affected first, and some of these workers perform functions on which much larger parts of the workforce depend.
- 2. Plan for continuity beyond the workplace.** Cooling and flexible work reduce direct exposure, but their effectiveness depends on reliable power, transport, communications, care services and the workers who sustain these systems.
- 3. Build the skills and labor-market agility needed for adaptation.** Climate disruption can reduce labor availability at the same time as demand rises for facilities, electrical, HVAC, safety, logistics and recovery skills. Over longer horizons, climate-related mobility can also change where workers and skills are available.
- 4. Coordinate adaptation locally.** Employers share infrastructure, service providers and pools of skilled labor; many workforce dependencies therefore cannot be managed by one company alone.

For employers and policymakers, these four shifts are both worker-protection measures and investments in business continuity. **Ultimately, climate resilience depends on people as much as infrastructure.**

Chapter 1

Why climate risk is workforce risk

Climate change is reshaping the world of work in two ways. The transition to a lower-carbon economy is changing which jobs are created, which activities decline and which skills employers need. At the same time, the physical effects of a changing climate are altering the conditions under which existing work can be performed. Heat can reduce the capacity to work safely and effectively. Floods and storms can prevent workers from reaching their workplace. Power failures can interrupt cooling, communications and remote work. Climate risk is therefore not only a question of which industries will grow or decline. It is also a question of **whether, where and under what conditions people can work.**¹

In the longer view, repeated disasters and slow-onset changes such as rising temperatures, drought, sea-level rise or deteriorating livelihood conditions can contribute to migration, displacement and planned relocation. Currently, much of this movement is expected to occur within countries, although climate and demographic pressures may also influence international migration. At the same time, the most vulnerable are often the least mobile: some households may lack the financial and social resources required to move. Climate

change may also shift where economic activity is viable or attractive, changing the geography of labor demand alongside the availability of workers and skills. Climate risk can therefore alter both where talent is available and where it is needed, reshaping local labor markets through mobility, involuntary immobility and shifts in economic activity.²

The scale of the challenge is already visible today. The International Labour Organization (ILO) estimates that 2.41 billion workers – around 70% of the global workforce – are exposed to excessive heat. Importantly, nine out of ten of these exposures occur outside formally defined heatwaves. Additional ILO modeling estimates that **heat stress could reduce total working hours worldwide by 2.2% by 2030 – equivalent to 80 million full-time jobs' worth of working time. The associated economic losses are estimated to be around US\$ 2.4 trillion by 2030**, enough to feature in the top 10 of the largest economies in 2025.³ Heat is therefore already a material workforce risk, and one that is expected to intensify as temperature continues to rise. For many workers and employers, changing climate conditions already make for an increasingly challenging operating environment.



1 OECD, The Economic Consequences of Climate Change, 2015, p. 23 and pp. 88–91; WHO/ WMO, Climate Change and Workplace Heat Stress: Technical Report and Guidance, 2025, pp. 2–4.

2 IOM, World Migration Report 2026, pp. 129–130

3 ILO, Heat at Work: Implications for Safety and Health – A Global Review of the Science, Policy and Practice, 2024, pp. 17–25; ILO, Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work, 2019, pp. 26–28.



But the effects are far from uniform. Heat stress reflects the interaction between environmental conditions, physical activity and clothing. Workers performing different tasks in the same location can therefore face very different risks. An office employee in a cooled building, a laboratory technician wearing protective clothing, a maintenance worker on a roof and a delivery driver may all work within the same business district while experiencing very different conditions. World Health Organization (WHO) and World Meteorological Organization (WMO) guidance similarly shows that even light or moderate work can create substantial physiological strain when environmental heat and other workplace factors combine.⁴

Climate risks can disrupt work even when the workplace itself is not directly damaged. Roads or public infrastructure may be disrupted, preventing the workforce from reaching the site. Power failures may stop cooling or communications. Employees may be dealing with damaged homes, school or care closures, or wider disruption to essential services. OECD analysis has long highlighted that extreme events affect economies not only through damage to physical assets, but through impacts on labor and indirect disruption to transport, electricity and local economic activity.⁵

This matters particularly in modern knowledge- and service-based economies. Indoor work can appear comparatively insulated from physical climate risk, particularly in countries where indoor cooling is

already common. Cooling, where available, can indeed substantially reduce direct heat exposure, while flexible working can provide another layer of resilience. Yet these adaptations also create dependencies. Offices, laboratories and technical workplaces rely on electricity, ventilation, digital infrastructure and the people who maintain these systems. Remote work provides limited protection when workers' homes lose power or cannot provide adequate thermal conditions, or when other essential services are unavailable. Adaptation can therefore reduce one form of direct exposure but does not eliminate dependence on climate-sensitive systems and conditions.

Existing evidence often examines climate hazards, occupational heat stress, asset resilience and broader economic effects separately. Organizations may therefore understand where climate hazards are increasing without having the same visibility on how different workers will be affected, whether people can reach work or whether critical support functions remain available. This separation is also reflected in established taxonomies on climate risk, which principally classify physical climate risks as acute or chronic but not necessarily how it affects a business through its workforce. Workforce risks can be reported through these channels, but workforce impacts are not typically assessed as a distinct risk pathway. The gap is not a lack of research on climate change and work; **it is the lack of integration between climate hazards, workforce exposure and operational dependence.**

4 WHO/WMO, Climate Change and Workplace Heat Stress, 2025, pp. 10–13, 20–23 and 55; ILO, Heat at Work, 2024, pp. 5–16.

5 OECD, The Economic Consequences of Climate Change, 2015, p. 23 and pp. 88–91.

To illustrate the consequences of considering these factors together, we use a place-based approach focused on business districts, which concentrate workers, employers, buildings and infrastructure within a defined geography. This allows physical climate signals to be interpreted alongside the mix of occupations, work settings and operational dependencies found in a local labor market. Our approach combines forward-looking physical climate analysis with a labor-market lens across three contrasting business districts: Barcelona's 22@ innovation district, Houston's Energy Corridor District and Singapore's one-north research and technology cluster. The locations are not intended to represent their countries or the global labor market. Instead, they ground our analysis in real-world work settings, allowing us to examine how climate, work and adaptation interact.

CLIMADA Technologies provides the location-specific climate analysis, including heat-related workability⁶, cooling pressure, heavy precipitation as a proxy for changing pluvial and urban flood pressure, and direct asset-repair downtime associated with tropical storms. The Adecco Group adds the labor-market perspective: who works in

these locations, what kind of work they perform, how physically demanding it is, how mobile or place-bound it may be, and which local systems enable people to continue working. Combining both perspectives, we explore how climate signals can be turned into a clearer picture for workforce-risk insights.

The objective is not to predict company output, realized productivity losses or permanent job losses. It is to explore a more practical set of questions: **Which workers may become exposed first? Which forms of work are easier to protect or reorganize? How far can adaptation reduce exposure, and which dependencies remain? And what does this mean for employers and labor-market policy?**

Looking at climate risk through a workforce-risk lens does not replace conventional analysis of buildings, infrastructure or financial exposure. It adds a human layer to it. Ultimately, businesses and economies depend not only on whether assets remain operational, but on whether people can continue to work safely and effectively, reach opportunities and adapt as conditions change.



⁶ The heat indicator represents a climate-driven reduction in potential work capacity under standardized conditions and explicitly excludes adaptations such as air conditioning, changed working hours or altered work practices.

Chapter 2

Study approach

A place-based approach allows climate and labor-market information to meet at the level where work is actually organized. Employers share buildings, transport networks, energy and communications infrastructure and local pools of specialized labor. The three locations were selected for contrast rather than statistical representativeness, combining different workforce profiles with different climate conditions.

Location	Workforce archetype	Principal value to the study
Barcelona 22@Poblenou	Urban innovation and knowledge-services district	Illustrates a predominantly indoor, knowledge-based district in a temperate European city where heat and cooling needs are rising from a comparatively low baseline.
Houston Energy Corridor District	Corporate energy, engineering and professional services district, with field-linked technical and support workforce	Combines office and technical employment with stronger links to physically active and field-based work, in a metropolitan area exposed to heat, heavy rainfall and storms.
Singapore one-north	Advanced R&D, technology and biomedical cluster	Illustrates highly cooled office, laboratory and technical work in a persistently hot and humid environment, with significant dependence on energy and specialized building systems.

The study combines two evidence layers: forward-looking physical climate analysis and information about each local workforce, workplace structure and labor-market context. Together, they move the

analysis from where climate conditions change to what those changes mean for people, work and continuity.

Climate risk modeling

The climate analysis provided by CLIMADA Technologies compares present-day climate conditions with how they could change under lower, intermediate and high-emissions futures.⁷ Results represent long-term climate conditions derived from 24 global climate models rather than forecasts of individual extreme events.

The analysis considers four principal indicators:

Heat-related workability estimates the share of potential working time lost due to heat under standardized conditions. It uses Wet Bulb Globe Temperature (WBGT), a standard occupational heat-stress measure, together with activity-specific heat-response functions. The primary model assumes shaded conditions, standard work clothing and no active cooling, and distinguishes low-, moderate- and high-intensity work because physical activity strongly changes heat sensitivity.

⁷ Shared Socioeconomic Pathways (SSPs) considered: SSP1-2.6 (low emissions; approximately 2°C of global warming by 2100 relative to pre-industrial levels), SSP2-4.5 (intermediate emissions; approximately 3°C warming), and SSP5-8.5 (high emissions; approximately 4.5°C warming). See also Annex II

Cooling pressure is measured using Cooling Degree Days above 20°C (CDD20), a climate indicator of how strongly outdoor conditions create a requirement for cooling. It is not an estimate of actual electricity use.

Heavy precipitation is measured as annual rainfall on extremely wet days, defined as days exceeding the historical 99th percentile of wet-day precipitation, and used as a proxy for changing pluvial or urban-flood pressure.

Tropical-cyclone asset downtime estimates the long-term average number of days per year that assets are unable to operate because of direct physical damage and repairs.

Labor market lens

The labor-market layer provides the context needed to interpret these physical indicators. To define each local lens, we developed a profile for each district, covering:

- employment and company scale;
- dominant sectors and workplace types;
- the likely distribution of office, laboratory, technical, support and production work;
- physical-activity assumptions;
- remote and hybrid working;
- commuting and transport dependence;
- building and cooling characteristics;
- labor-market conditions, skills and institutional capacity.

Public data is supplemented by proprietary labor market data and qualitative feedback from local labor market experts within the Adecco Group.

Synthesis and limitations

Our analysis follows a simple analytical chain:

Physical climate signal → workers and workplaces exposed → sensitivity of work and operations → potential workforce effects → adaptation and response

This structure prevents the physical hazard from being treated as the workforce outcome. A high heat indicator does not automatically translate into the same impact across all workers. Workers in cooled offices, ventilated laboratories, and outdoor maintenance roles can face the same external climate while experiencing very different consequences.

The locations are illustrative, and physical activity shares within the workforce are informed assumptions. In the future scenarios, only the climate changes: the analysis does not forecast how the districts' workforce, buildings or adaptation measures may evolve. The analysis therefore identifies potential exposure and resilience mechanisms rather than realized productivity, output or employment outcomes; further methodological detail is provided in Annex II.



Chapter 3

Comparative findings and workforce implications

The analysis reveals a consistent pattern: the jobs that matter most to keeping districts functioning are often the least mobile, most physically demanding and most exposed to climate hazards. Although exposure levels and rates of change differ substantially across locations, all three districts rely on a relatively small group of roles that carry disproportionate operational importance. We first compare the physical climate signals across the three districts, then examine how workforce characteristics and adaptation dependencies shape what those signals mean in practice.

Our model shows three distinct profiles: Singapore faces the highest absolute heat-related loss of potential working time and cooling pressure; Houston combines substantial present-day heat exposure with the broadest mix of heavy-rainfall and tropical-cyclone risks; while Barcelona starts from a much lower baseline but faces the strongest proportional increase in heat and cooling, creating strong adaptation pressure. Adding the workforce layer to these profiles, we estimate mixed-workforce **heat-related workability loss at 4.1% of potential**

annual working time in Singapore and 2.7% in Houston, compared with 0.1% in Barcelona. For scale, these standardized losses for under current conditions would correspond to around 10 days of potential working time in Singapore, 7 days in Houston and less than one day in Barcelona. By mid-century, the ranges across climate scenarios rise to 6.2–7.8%, 4.2–5.2% and 0.3–0.4%, respectively. Under the high-emissions scenario at end-century, they reach 15.4% in Singapore, 9.4% in Houston and 1.3% in Barcelona – see Figure 1.

Heat-related loss of potential annual working time (%)

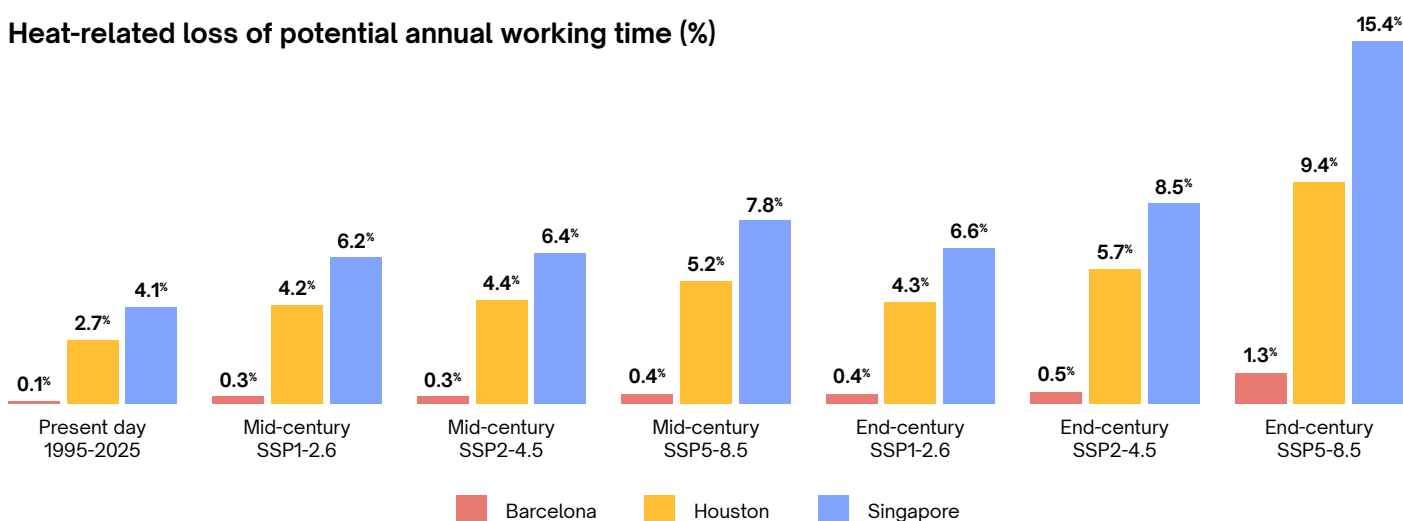


Figure 1. Mixed-workforce heat-related workability loss

The results are standardized heat-workability estimates, not forecasts or realized productivity loss. Absolute levels, however, tell only part of the story: each location must adapt from its own baseline. Barcelona's heat-related workability loss remains well below Singapore's present-day level, but will more than double by mid-century across all climate scenarios and increase more than tenfold by end-century. For a city whose buildings, infrastructure and work practices have developed around a much lower heat baseline, that scale of change is set to place significant pressure on existing systems.

Models for cooling demand, illustrated in Figure 2, show a similar pattern. While Singapore remains the most cooling-intensive environment, Barcelona experiences the strongest proportional increase, with cooling needs projected to rise by around 152% by the end of the century. This matters for workforce resilience because cooling-based adaptation strategies depend on reliable electricity, cooling systems and the specialist workers who maintain them.

Cooling pressure (cooling degree days above 20°C)

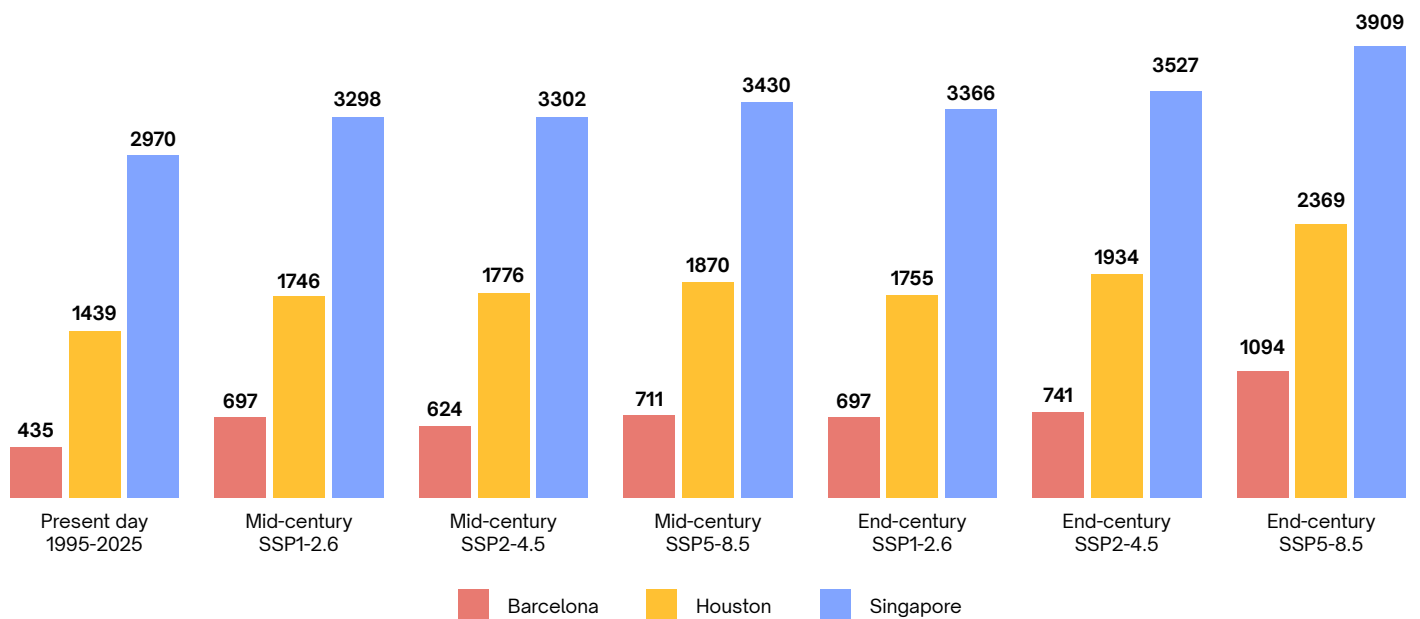


Figure 2. Cooling degree days above 20°C.

Cooling pressure (cooling degree days above 20°C)

Location	Heat-related workability	Cooling pressure	Heavy precipitation	Tropical-cyclone asset downtime
Barcelona	Low baseline; increasing	Low baseline; strongest proportional increase	Weak/inconsistent future signal	Not material in this analysis
Houston	Present and increasing	Present and increasing	Increasing	Present and increasing
Singapore	Highest absolute level; increasing	Highest absolute level; increasing	Increasing	Not material in this analysis

Table 1. High-level multi-hazard comparison. Heavy precipitation is measured as precipitation on extremely wet days and acts as a proxy for changing pluvial or urban-flood pressure. A weak or inconsistent future climate-change signal does not imply an absence of current flood risk. These indicators describe inherent physical conditions rather than realized business outcomes. Their value lies in identifying the physical conditions that workers and workplace systems may increasingly need to offset.

Physical work intensity creates resilience bottlenecks



Workforce risk is not evenly distributed across occupations. More importantly, the most exposed occupations are often those on which many other workers depend. The factor that creates much of this outsized exposure of a relatively small part of the workforce is the physical intensity of work. To test this, we model sensitivity cases that show what would happen if all workers in each location performed either low-, moderate- or high-intensity work.

The results show that physically demanding work is much more affected by heat under the same climate conditions. Even under present-day conditions, high-intensity work could lose around 44% of potential annual working time in Singapore and 17% in Houston, compared with around 1% or less for low-intensity work. Even in Barcelona, where the overall heat signal is small, the high-intensity case reaches around 2%, while low-intensity work remains close to zero.

This matters because all three business districts are dominated by knowledge, office or technical employment, but none consists only of sedentary office workers. Maintenance, facilities, logistics, security, construction, repair and some field-linked technical roles are more physically demanding. Many are also place-bound: physical intensity increases inherent heat exposure, while being place-bound reduces the options to avoid or reorganize it. The illustrative workforce mixes assume that high-intensity activity accounts for 5% of workers in Barcelona and Singapore and 10% in Houston.

Combining these workforce shares with the activity-specific results indicates that this relatively small group contributes a disproportionate share of present-day heat-related workability loss. Despite their smaller share of total employment, disruption to these roles can create knock-on effects for workers whose own direct exposure is much lower. The precise contribution is an indicative calculation and is therefore reported in Annex II alongside the detailed activity results.

The pattern also changes as warming increases. By the end of the century under a high-warming scenario, modeled low-intensity workability reduction rises to 10.4% in Singapore and 5.4% in Houston, while remaining substantially lower at 0.6% in Barcelona. Heat exposure therefore begins as a highly concentrated occupational challenge but becomes a broader question of work organization as climatic conditions worsen. This does not mean that every desk worker will experience the standardized loss: cooling and other adaptations remain decisive. It does mean that long-term heat resilience cannot be confined to occupations traditionally considered heat-exposed.

Adaptation reduces exposure but depends on resilient systems

Cooling is the clearest example of why inherent exposure and potential workforce outcomes differ. In Singapore and Houston, widespread cooling is likely to protect much of the office workforce from the direct ambient heat represented in the unadapted model. This protection remains beneficial, but it depends on reliable supporting systems.

Singapore one-north contains a large office workforce alongside laboratories and technical facilities where cooling and ventilation are important for safe and continuous operation. Local expert feedback suggests that larger employers generally already have mature continuity arrangements, including backup power, contingency cooling, emergency protocols and hybrid working. Its high and rising cooling pressure therefore points not simply to likely operational disruption, but to the continued importance of reliable electricity, HVAC and building systems, as well as the specialist workers who operate and maintain them. Many of these roles are place-bound and may face greater direct heat exposure than the office workforce that depends on them.

Houston shows a similar but more heterogeneous pattern. The Energy Corridor District is predominantly white collar, yet local feedback identifies a smaller group of facilities, security, logistics, field-service and emergency roles whose exposure is harder to

avoid. Cooling can protect the corporate workforce while leaving these workers more directly exposed; power disruption can also remove that protection. Hybrid work is common among white-collar employees, but becomes a weaker adaptation where household electricity, roads or care services are disrupted.

Barcelona starts from a different position. Its absolute heat and cooling levels remain substantially lower, but both increase rapidly from a historical baseline to which buildings and workplace practices have adapted. Barcelona is therefore less a case of high current exposure than of emerging adaptation pressure: practices that were adequate under past summer conditions may need to evolve as cooling requirements and heat exposure increase.

Across the three locations, the wider lesson is that **adaptation reduces direct exposure, but it does not insulate the workforce from climate risk.** Cooling shifts part of the risk towards power and HVAC reliability; remote work shifts part of it towards household power, communications and care arrangements. Resilience therefore depends not only on whether an adaptation measure exists, but on which workers can use it and which systems must remain functional for it to work. **Crucially, adaptation is an ongoing process to build resilience, not a one-off intervention.**





When climate disruption changes labor availability and skills demand

Heat is not the only relevant physical risk. Under a high emissions scenario, heavy precipitation is projected to increase 45% in Houston and 62% in Singapore by end-century, while the signal is weaker and less consistent across scenarios in Barcelona. Tropical-cyclone-related asset downtime is relevant only in Houston among the locations assessed, with the model indicating increasing downtime towards the end of the century, particularly under high emissions.

These indicators also illustrate why asset risk and workforce risk need to be distinguished. Heavy precipitation signals changing climatic pressure but does not model drainage capacity, road flooding or whether workers can reach a workplace. Similarly, our cyclone indicator estimates average annual downtime resulting from direct physical damage to assets. It does not capture precautionary closures, grid failure, commuting disruption, employee displacement or interruptions to care and public services, which could further add to disruption.

Houston makes this distinction tangible: disruptive events already cause road obstruction, household power loss, displacement and school closures, reducing labor availability even where well-protected corporate facilities could reopen. At the same time, recovery increased demand for field engineers, electricians, HVAC specialists and facilities personnel.

A climate event can therefore **reduce the supply of available labor without directly damaging the workplace – and simultaneously increase demand for the workers needed to restore operations in the short term.**

Over longer time horizons, labor markets will also be shaped by climate-related migration and displacement as climate impacts intensify. Indeed, the World Bank-published report estimates that up to 216 million people could become internal climate migrants by 2050 across six world regions without sufficient climate and development action.⁸

This should not be interpreted as evidence that workability losses are the primary cause of these labor shortages. Migration is multi-causal, and our scenarios deliberately hold the location and composition of the workforce constant. The longer-term implication is instead that climate change may redistribute labor supply between local labor markets. Areas experiencing deteriorating livelihoods may lose workers and skills, while destination regions may need to absorb additional workers and match their capabilities with local demand. Nor will everyone be able to move: severe climate impacts can erode the resources required for migration, leaving some vulnerable populations involuntarily immobile.⁹

Beyond mid-century, workforce resilience may therefore depend increasingly not only on adapting work in place, but also on the capacity of labor markets to manage mobility, relocation and changing geographical patterns of labor supply.

⁸ Clement, Vivane et al., Groundswell Part 2: Acting on Internal Climate Migration, World Bank, 2021, p.80

⁹ IOM, World Migration Report 2026, pp. 129-130

What the comparison tells us

Four conclusions emerge from integrating the climate and labor-market evidence.

1

Average workforce exposure can hide the people most at risk and the roles on which others depend.

Physical intensity, work location, clothing and control over working time shape exposure. Physically demanding roles are affected first, but as warming intensifies, lower-intensity work increasingly enters the exposure profile.

2

Adaptation reduces direct exposure but does not make the workforce independent of climate risk.

Cooling, remote work and resilient buildings depend on power, transport, digital infrastructure and specialized support workers. Exposure is also not limited to the workplace: workers may remain exposed through conditions at home or during their commute.

3

Climate risk can change both where labor is available and which skills are needed.

Acute disruption may prevent some workers from working while increasing demand for occupational safety, facilities, electrical, HVAC, logistics and recovery skills. Over longer horizons, climate-related migration, displacement and relocation can also change where workers and skills are available, creating different adjustment pressures for origin and destination labor markets.

4

Workforce resilience depends on shared local systems.

Employers rely on transport, energy, care services, infrastructure operators, service providers and local pools of skilled labor that no individual company controls.

The analysis does not identify a single “most vulnerable” district. Instead, it shows that workforce resilience is shaped by the interaction between physical hazards, the tasks people perform, where and how work is organized, and the infrastructure, systems and skills that allow workers and employers to adapt. These findings provide the basis for the practical agenda in the next chapter.

Chapter 4

Practical agenda for workforce resilience - key recommendations for employers and policymakers

The comparison points to a practical question: **when climate conditions deteriorate, are enough people with the right skills still able to work, reach workplaces and keep critical systems running?**

This supports four practical shifts for workforce resilience: protect exposed workers; plan for workforce continuity; build skills and labor-market agility; coordinate adaptation locally.

Protect the workers who carry the greatest exposure

The analysis shows why workforce averages are insufficient. In Barcelona, Houston and Singapore, high-intensity work produces far greater modeled heat-related loss than low-intensity work under the same climate conditions. This matters particularly for facilities, maintenance, construction, logistics, security, field-service and emergency-response roles. Physical intensity raises inherent heat exposure, while many of these roles are also place-bound and therefore harder to reorganize or perform remotely.

Employers should therefore **assess heat exposure by task and work setting**, not simply by sector or corporate workforce profile. Priority should reflect both direct exposure and operational criticality, especially for physically demanding and place-bound work. Heat plans should include practical controls such as hydration, cool rest areas, acclimatization, adjusted schedules and work-rest arrangements. They should also establish clear escalation or stop-work criteria and ensure managers and workers are trained to recognize heat stress. Occupational-health processes should identify workers who may require additional protection, with appropriate privacy safeguards.

The ILO's review of national approaches finds that many heat provisions remain general and highlights the value of risk-based measures tailored to actual working conditions, including protection whenever excessive heat presents a risk rather than only during formally defined heatwaves.¹⁰ Governments have an important role in ensuring that Occupational Safety and Health (OSH) frameworks provide a clear and enforceable minimum level of protection against excessive heat. This helps create a level playing field in which competition does not come at the expense of worker safety, while allowing measures to be adapted to actual workplace risks.

Measures also need to apply across employment arrangements. Contingent workers and those in diverse forms of work may be subject to the same on-site safety requirements as directly employed staff while having different or insufficient access to paid emergency leave or income protection when sites close. Employers should test whether climate-related safety and continuity arrangements extend across their full workforce, including agency workers, contractors and outsourced service providers. Policymakers should ensure that basic protections and access to labor-market support do not disappear when workers move between employers or contract types.

¹⁰ ILO: Heat at Work: Implications for Safety and Health – A Global Review of the Science, Policy and Practice, Geneva, 2024, pp. 38-45, 53-64 and 75-77.

Plan for workforce continuity, not only asset continuity

Continuity plans should test workforce as well as asset failure modes. Scenarios should include transport disruption, childcare or other care-service closures, household power or communications outages, elevated absenteeism and the temporary loss of critical on-site staff. Employers should identify which roles require physical presence, where minimum staffing or specialist skills have limited backup, and what alternatives exist if the usual workplace or remote-work arrangements become unavailable. Because cooling itself depends on electricity, HVAC systems and on-site specialists, these dependencies – and the workers who sustain them – should be treated as part of workforce resilience, not only facilities management.

Many of these dependencies sit beyond the control of an individual employer. Public adaptation planning should therefore consider whether electricity grids, transport networks, telecommunications and digital infrastructure can support the workforce adaptations expected of businesses, including greater cooling and remote work. This should include testing whether infrastructure can remain reliable during periods of peak heat or severe weather, when multiple employers and households may depend on the same systems at the same time. Where adaptation costs or capacity constraints are significant, particularly for smaller firms, governments can also use targeted finance, technical support or incentives to help viable measures scale.

Build skills and labor-market agility for climate adaptation

The analysis identifies an immediate labor-market challenge: **physical climate disruption can create simultaneous labor shortages and spikes in demand for resilience-related skills.** Some workers may temporarily be unable to work, while demand rises sharply for safety, facilities, electrical, HVAC, construction, logistics and recovery expertise. Employers, training providers and public employment services should therefore anticipate adaptation-related skills requirements early, assess whether labor markets can supply the skills and experts needed and expand reskilling and rapid training pathways before shortages become bottlenecks. Indeed, feedback from Singapore highlights that several of these resilience-related skills, including energy management and business continuity, are already in short supply.

Short-time work, temporary income support and emergency leave can serve as immediate response measures to help preserve employment relationships during temporary disruption rather than forcing a choice between unsafe work and job loss. The COVID-19 pandemic provides a useful even if not directly equivalent precedent for this.¹¹

In the long run, climate-related migration and displacement can reduce labor supply in some areas while increasing the number of workers seeking opportunities elsewhere. Labor-market policy therefore needs to anticipate not only occupational transitions, but mobility between places. For more structural change, effective skills recognition, fair recruitment, portable social protection and support for integration can help workers move between occupations and locations, while measures that enable people to remain safely in their communities remain important where adaptation in place is viable.¹²

Much of our ability to adapt to a changing climate will rest on agile labor markets and it will take closer cooperation between employers, public employment services and private employment providers to unlock this. The objective is not to create a separate “climate labor market”. **It is to make existing labor-market institutions more responsive to climate-related shocks.**

¹¹ See also Adecco Group, Comparing the outcome of Government responses to Covid-19, 2022, accessible at <https://www.adeccogroup.com/-/media/project/adecco-group/adeccogroup/articles/article-doc/tag-covid-19-government-response-outcomes-comparison-january-2022.pdf>

¹² See also ILO, Human mobility and labour migration related to climate change in a just transition towards environmentally sustainable economies and societies for all, Just Transition Policy Brief, 2022, pp.7-9

Build resilience locally and collectively

Finally, no location can be made workforce-resilient by individual employers alone. Workers depend on transport, energy, communications, care services and public infrastructure. Employers depend on contractors, landlords, service providers and common pools of skilled labor. Protecting workers is not only the right thing to do; it is also a critical investment in business continuity.

In practice, climate adaptation often succeeds or fails at the level of the local labor market, where employers share infrastructure, service providers and talent pools. Employers, local authorities, worker representatives, employment services, training providers and infrastructure operators should thus jointly identify vulnerable workforce groups, critical occupations and common points of failure. Risk management and disclosure frameworks can support this shift by making workforce exposure more explicit when companies assess acute and chronic physical climate risks.

The conclusion is clear: workforce protection and resilience should be a core part of climate adaptation planning, alongside physical infrastructure and asset resilience.

This means protecting the most exposed workers, maintaining access to work during disruption, building the skills required for adaptation, and ensuring that labor markets can re-employ people and capabilities as conditions change.

Physical adaptation can reduce exposure, but its effectiveness depends on those who operate workplaces, maintain critical systems, respond to disruption and have the skills to fill the roles that become more important as climate conditions change. Resilient labor markets therefore need both protection and adaptability: safeguards that reach all forms of work, institutions that support transition and employers and public actors able to respond together when climate disruption becomes workforce disruption.

Climate resilience ultimately depends not only on infrastructure, but on people: their safety, skills, adaptability, mobility and ability to keep critical systems running.



Annex I

Location profiles



Barcelona 22@ Poblenou

A fast-emerging adaptation challenge in a predominantly knowledge-based labor market

Barcelona's 22@ district combines around 115,000 jobs and more than 12,000 companies with a predominantly technology, innovation and knowledge-services economy. Current heat-related

workability risk is comparatively modest, but the district illustrates how a temperate, office-heavy labor market may need to adapt as heat and cooling pressure rise.¹³

Indicator	Key result
Heat-related workability	>10 fold increase by end-century 0.12% today -> 0.28-0.42% mid-century -> 1.34% end-century SSP5-8.5
Cooling pressure, CDD20	+152% by end-century 435 today -> 624-711 mid-century -> 1,094 end-century SSP5-8.5
Heavy precipitation	+6-14% by end-century 36 mm today -> 40-42 mm mid-century -> 38-41 mm end-century
Tropical-cyclone downtime	Not material in this analysis

¹³ Barcelona City Council, 22@ Barcelona Innovation District, 2024, key figures and project overview

Barcelona has the lowest absolute heat and cooling exposure, but the strongest proportional increase. Heavy precipitation is projected to increase modestly, although the climate-change signal is weak and does not show clear differentiation across emissions scenarios.

The low district average masks substantial differences by task and physical activity intensity. Under present conditions, the high-intensity sensitivity case is already around 2% while low-intensity work is close to zero. Facilities, maintenance, logistics, construction, hospitality, security and other place-bound roles therefore face a different exposure profile from the dominant office workforce.

For the larger knowledge workforce, the issue is adaptation to a changing thermal baseline. Cooling needs may rise unevenly across modern offices, research facilities and converted industrial stock. Flexible work offers some resilience, but remains occupation-dependent: across Catalonia, 17.6% of employed people teleworked in 2025, while 66.2% reported that their job did not allow it.¹⁴

Even if Barcelona starts from a lower baseline in terms of climate risks in our analysis, it does not start from zero on occupational heat. Spain already has an established occupational-heat framework, combining legal requirements with practical

guidance on measures such as adapting working hours, hydration, rest breaks and scheduling strenuous work during cooler periods. As particularly heat exposure increases, the challenge will be to ensure these existing practices remain adequate for quickly changing conditions.

Employer adaptation priorities

- Map heat exposure by task, physical effort and work setting, including contractors and more exposed roles in facilities, maintenance, cleaning, security, hospitality, logistics and construction. Link heat protection to continuity planning by identifying critical on-site roles, minimum staffing needs and backup arrangements during extreme-heat periods.
- Maintain heat protocols with clear triggers for measures such as hydration, rest breaks, adjusted schedules and moving strenuous work to cooler periods. Also consider that triggers for at-risk populations and those with lower tolerance to heat might need to be adjusted accordingly.
- Review whether ventilation, shading, cooling and other workplace adaptations remain adequate as heat exposure increases, while using flexible scheduling or hybrid work where feasible.



¹⁴ Statistical Institute of Catalonia (Idescat), Survey on ICT Equipment and Use in Households, 2025, published 30 January 2026.

Houston Energy Corridor District



A predominantly white-collar workforce where heat, mobility and recovery risks converge

Houston demonstrates why workforce climate risk cannot be inferred from sector labels alone. The formal Energy Corridor District supports 64,656 jobs, with professional, scientific and technical services accounting for 25% of employment.¹⁵

At the same time, the district is closely connected to engineering, field operations and the wider Houston energy economy, creating a smaller but strategically important workforce in facilities, field service, security, logistics and emergency response.

Indicator	Key result
Heat-related workability	+248% by end-century 2.71% today -> 4.19-5.22% mid-century -> 9.44% end-century SSP5-8.5
Cooling pressure, CDD20	+65% by end-century 1,439 today -> 1,746-1,870 mid-century -> 2,369 end-century SSP5-8.5
Heavy precipitation	+21-45% by end-century 66 mm today -> 78-88 mm mid-century -> 80-96 mm end-century
Tropical-cyclone downtime	Up to +19% by end-century 1.6 days today -> 1.6-1.7 days mid-century -> 1.6-1.9 days end-century

¹⁵ Energy Corridor District, “Energy Corridor District Packs Big Economic Punch”, 2026, reporting its newly commissioned 2025 economic analysis: 64,656 district jobs, 25% in professional, scientific and technical services and average annual salary of USD 86,100.

Houston has the broadest risk mix: heat and cooling are already material, heavy precipitation is relevant and average annual tropical-cyclone asset downtime due to tropical-cyclones is expected to increase further. Disruptions during severe storms in the past indicate that workforce disruption can extend well beyond direct asset damage. In our present-day sensitivity analysis, the uniform low-intensity case is below 1%, the moderate case is approximately 3%, while a workforce performing only high-intensity activity reaches roughly 17% modeled workability loss. These are standardized uncooled sensitivity cases rather than realized losses, but they highlight which workers require particular attention.

Local feedback helps identify those groups. Facilities and landscaping workers may operate on roofs, loading docks and in mechanical spaces; security staff divide time between conditioned and outdoor environments; technicians and laboratory workers may work in testing bays or travel to operational sites; logistics workers operate in semi-conditioned loading areas; and emergency and utility workers may face their highest workload precisely during disruptive weather. Houston therefore adds an important nuance to the comparative finding on physical intensity: a business district can be overwhelmingly white collar while still depending on a relatively small workforce for whom heat exposure is both higher and harder to avoid.

The larger Houston workforce faces another channel of risk. Air conditioning is widespread, so the modeled 2.71% reduction in workability should not be treated as the likely loss for an office worker in normal conditions. Nonetheless, cooling protection depends on electricity and varies in resilience between workplaces. While major corporate and technical facilities can have robust backup arrangements, disruptions during severe weather in the past have highlighted that other workplaces may be less able to maintain full cooling through a prolonged outage. Rising CDD therefore matters partly because it increases the importance of keeping workers in safe indoor conditions rather than because every office worker experiences outdoor heat directly.

Houston also illustrates most clearly why workforce downtime can exceed asset downtime. Recent local experience points to flooded or obstructed roads at low-lying inter-sections on important commuting routes, household power outages, displacement and school closures restricting employees' ability to commute or work remotely even where an office itself can reopen. At the same time, recovery increases demand for field engineers, electricians, HVAC specialists and facilities personnel. Climate shocks can therefore simultaneously reduce ordinary labor availability and create acute shortages in the skills needed to restore operations.

Employer adaptation priorities

- Map heat exposure by task, physical effort and work setting, including contractors and more exposed roles in facilities, maintenance, cleaning, security, hospitality, logistics and construction. Also consider other relevant characteristics that may impact heat tolerance at a personal level.
- Maintain heat protocols with clear triggers for measures such as hydration, rest breaks, adjusted schedules and moving strenuous work to cooler periods.
- Link heat protection to continuity planning by identifying critical on-site roles, minimum staffing needs and backup arrangements during extreme-heat periods. Also extend this beyond the workplace for workers who cannot safely commute or do not have access to adequate conditions to work remotely.
- Review whether ventilation, shading, cooling and other workplace adaptations remain adequate as heat exposure increases, while using flexible work where feasible.

Singapore one-north



High inherent heat exposure in a highly-adapted labor market built around cooling and specialized on-site work

Singapore one-north combines over 50,000 knowledge workers with a dense concentration of biomedical sciences, technology and engineering R&D, digital services, media and research institutions. It also has a growing presence of AI and data science, semiconductor and advanced manufacturing.

The workforce figure may be conservative given the estate's continued growth and it may not fully capture facilities, security, cleaning, maintenance, transport and contractor workforce that support the district. It is the clearest case of high inherent heat exposure coexisting with a highly cooled, knowledge-intensive labor market.

Indicator	Key result
Heat-related workability	+274% by end-century 4.10% today -> 6.16-7.84% mid-century -> 15.35% end-century SSP5-8.5
Cooling pressure, CDD20	+32% by end-century 2,970 today -> 3,298-3,430 mid-century -> 3,909 end-century SSP5-8.5
Heavy precipitation	+26-61% by end-century 87 mm today -> 113-114 mm mid-century -> 110-140 mm end-century
Tropical-cyclone downtime	Not material in this analysis

Singapore has the highest absolute heat-related workability loss and cooling pressure, alongside a relevant heavy-precipitation signal; tropical-cyclone downtime is not material. The workforce challenge is therefore persistent heat, cooling dependence and access for place-bound laboratory, technical and support work.

Singapore also shows why physical intensity remains important even where manual work represents only a small share of employment. Already under current conditions, our sensitivity analysis produces approximately 1.4% workability reduction for a uniform low-intensity workforce, around 6.6% for moderate activity and more than 44% for high-intensity work. The high-intensity case should not be interpreted as a realized district-wide outcome, but demonstrates the much narrower margin available to workers undertaking physically demanding activities in Singapore's hot and humid climate. Local labor market experts validate the physical activity mix used for our model but also reinforce the outsized operational importance of the 5% minority of high-physical activity workforce.

Yet the more distinctive one-north finding concerns the majority of its workforce. Office, scientific and laboratory staff generally work in actively cooled environments. Mechanical cooling therefore separates the inherent heat signal from what these workers normally experience. At the same time, Singapore already records 2,970 CDD20 – more than twice Houston's present value – and reaches 3,909 under end-century SSP5-8.5. Air conditioning and mechanical ventilation already account for an estimated 40–60% of building electricity consumption in Singapore.¹⁶ For an estate with laboratories and specialized research facilities, cooling and ventilation are often conditions for performing work safely and continuously, rather than simply amenities. The case of Singapore one-north therefore underscores that even where adaptation is already working, climate risks increase resilience pressure and will continuously raise the standards that adaptation systems must meet.

This creates a different form of workforce dependency. Remote work can provide resilience for some knowledge-based roles: nationally, 38.4% of employers offered scheduled teleworking in 2024, but many laboratory, technical and support activities require people to be physically present.¹⁷ Singapore therefore illustrates most clearly how adaptation can protect workers from direct climate exposure while increasing the importance of reliable systems and the specialist people who maintain

them. This includes a wider ecosystem of support workforce across facilities, maintenance and contracted services.

There is also evidence that practical heat adaptation can work. The ILO's 2024 review describes Singapore's HeatSafe trial at an outdoor construction site, which combined heat education, additional shaded breaks, cold water and more heat-dissipating workwear. Workers recorded a 10% higher step count and 14% higher step rate on the intervention day, while supporting the measures in subsequent feedback.¹⁸ The setting differs from one-north, but the lesson is relevant to its more exposed workforce: protection does not necessarily require a trade-off between worker health and the ability to perform work.

The more persistent labor-market constraint may instead be the availability of resilience-related skills. Local stakeholder feedback identifies already-tight talent pools in facilities engineering, HVAC and building systems, building automation, energy management, business continuity and occupational health and safety. These capabilities are likely to become more important as cooling and climate-resilience requirements increase.

Employer adaptation priorities

- Maintain robust heat protection and continuity arrangements for outdoor, semi-conditioned and physically demanding roles, including facilities, maintenance, security, cleaning, transport and contractor workforce: heat monitoring, acclimatization, hydration, cool rest, appropriate clothing and work-rest arrangements.
- Treat cooling, ventilation, backup power and building automation as workforce-continuity systems, particularly for laboratories and specialized R&D environments where work cannot readily move elsewhere.
- Build and retain capability in facilities engineering, HVAC, energy management, building automation, business continuity and occupational health and safety, where local talent is already tight.
- Maintain flexible-work and access arrangements for heavy-rain and other short-term mobility disruption, with particular attention to laboratory, facilities and support roles that remain place-bound.

¹⁶ National Climate Change Secretariat (NCCS), "Buildings", Singapore's Climate Action – Mitigation Efforts, accessed 12 August 2026, <https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/buildings/>

¹⁷ Singapore Ministry of Manpower, "Written Answer to PQ on Work-from-home policies since the pandemic", 5 November 2025.

¹⁸ ILO, Heat at Work: Implications for Safety and Health – A Global Review of the Science, Policy and Practice, 2024, p. 71.

Annex II

Methodological notes, results and calculations

Annex II provides the technical assumptions and supplementary calculations underlying the main analysis. These materials are separated from the main body to preserve readability while allowing the results to be reviewed and interpreted. They include the climate-model framework, indicator definitions, workforce assumptions, sensitivity analyses, indicative working-time translations and the principal limitations of the study.

1. Climate scenarios, datasets and modeling

The climate analysis considers SSP1-2.6, SSP2-4.5 and SSP5-8.5. Results are reported for a present-day reference period (1995-2025), mid-century (2035-2065) and end-century (2065-2095). Indicators are derived from 24 global climate models in NASA's NEX-GDDP-CMIP6 bias-corrected and statistically downscaled daily projections. Unless otherwise stated, results are the multi-model median for a typical year in the respective period. They should therefore be interpreted as long-term climatological signals rather than forecasts for individual extreme years.

Climate indicators are evaluated at approximately 0.25 degree resolution. The results therefore capture the broader local climate rather than street-, building- or microclimate-level variation within each district. Temperature is adjusted for local elevation using a higher-resolution digital elevation model and a standard lapse-rate assumption. Employment, buildings and adaptation are held constant through the future scenarios: the exercise is a climate-sensitivity assessment rather than a socioeconomic forecast.

Tropical cyclone hazard is modeled globally using simulated storm tracks based on historical observations and a parametric wind model to estimate associated wind speeds. Historical storm tracks from IBTrACS are statistically perturbed to represent a wide range of possible tropical cyclone events. Future conditions account for projected changes in tropical cyclone frequency and intensity across regions and emissions scenarios, based on the latest scientific literature.

2. Heat, cooling and other hazard indicators

Daily shaded WBGT is estimated from elevation-adjusted air temperature and relative humidity. CLIMADA Technologies applies continuous heat-sensitivity functions for low-, moderate- and high-intensity activity, drawing on published epidemiological and occupational-heat literature and ISO 7243. The primary results assume shade, standard work clothing and no active cooling. The model does not include altered working hours, additional breaks, remote work or other behavioral and workplace adaptations.

Cooling pressure is calculated as annual Cooling Degree Days. CDD20 is used for the principal comparison, while 18°C and 22°C base temperatures are available as sensitivity cases. CDD is a climate indicator rather than a direct estimate of electricity use: realized energy demand also depends on building design, internal and solar gains, occupancy, ventilation, air-conditioning prevalence, system efficiency and behavior.

Heavy precipitation is assessed as the total rainfall from exceptionally wet days, defined as days exceeding the 99th percentile of wet-day precipitation during the historical reference period (1985–2014). The indicator is based on daily, spatially aggregated climate data and therefore does not fully capture short, localized convective events or local factors such as drainage capacity, impervious surfaces and topography that influence urban flood risk.

Tropical-cyclone downtime represents expected annual downtime due to direct physical damage to assets and subsequent repairs. It excludes precautionary closures, power and communications outages, transport disruption, damage to workers' homes and wider recovery effects. Results are expressed as average annual downtime, representing the expected number of downtime

days per year over the long term. Actual downtime can vary considerably from year to year: many years may have no disruption, while a severe event can cause substantial downtime.

Sensitivity analysis tests how strongly the results depend on selected modeling assumptions. In this study, two principal sensitivity tests are used. For heat, the model compares the location-specific

mixed workforce with hypothetical workforces performing entirely low-, moderate- or high-intensity activity. For cooling, Cooling Degree Days are recalculated using alternative base temperatures of 18°C and 22°C around the principal 20°C assumption. These tests do not represent alternative forecasts; they help show which findings remain consistent when key assumptions are changed.

3. Workforce assumptions and activity sensitivity

The heat model requires physical-activity shares rather than conventional occupational categories. The primary illustrative mixes are **Barcelona 80% low / 15% moderate / 5% high; Houston 75% / 15% / 10%; Singapore 85% / 10% / 5%.**

These are informed modeling assumptions based on the district employment profiles, public labor-market evidence, Adecco Group expertise and local validation; they are not measured occupational distributions.

Physical activity	Barcelona	Houston	Singapore
Low	0.01% -> 0.58%	0.73% -> 5.37%	1.44% -> 10.44%
Moderate	0.08% -> 2.06%	2.88% -> 12.79%	6.65% -> 27.51%
High	1.98% -> 11.30%	17.25% -> 34.86%	44.29% -> 74.47%

Table All.1. Activity-specific potential annual working-time loss: present day -> end-century SSP5-8.5. Uniform-activity cases are sensitivity tests and do not describe the whole district workforce.

To illustrate how workforce composition influences the mixed result, the activity-specific multi-model medians were weighted by the assumed workforce shares. The resulting contribution estimates are indicative rather than separate CLIMADA

Technologies model outputs because the published mixed-workforce result is calculated within the model workflow before the multi-model median is taken.

Heat exposure shifts from concentrated to broader across the workforce

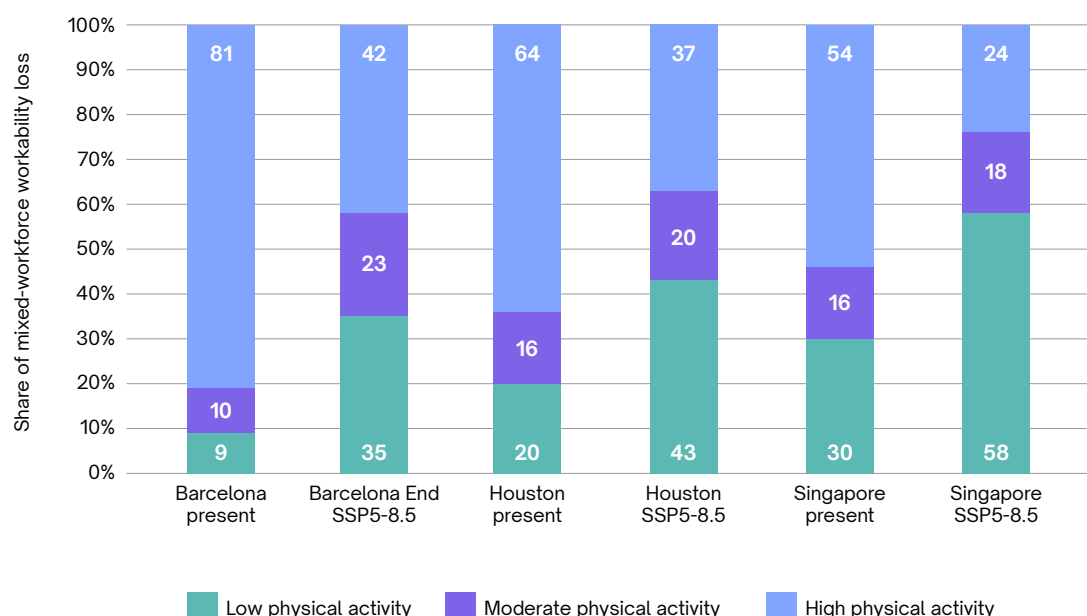


Figure All.1. Approximate contribution of each activity group to the mixed-workforce result. Small differences from the published mixed result reflect the order of aggregation.

4. Indicative translation to potential working hours

The following calculation provides a common workforce scale for interpreting the percentage results. It is not an estimate of realized output, absence or jobs lost. Potential working hours are

calculated as employment x 2,000 standardized annual hours x modeled mixed-workforce loss rate. FTE-equivalent working time is shown only as an analytical comparison.

Location	Employment base	Present day	Mid-century range	End-century SSP5-8.5
Barcelona	115,000 jobs	0.28m h 140 FTE-eq.	0.65-0.97m h 326-484 FTE-eq.	3.09m h 1,545 FTE-eq.
Houston	64,656-71,000 jobs	3.51-3.85m h 1,753-1,925 FTE-eq.	5.42-7.41m h 2,712-3,706 FTE-eq.	12.21-13.41m h 6,107-6,706 FTE-eq.
Singapore	At least 50,000 workers	>=4.10m h >=2,052 FTE-eq.	>=6.16-7.84m h >=3,082-3,920 FTE-eq.	>=15.35m h >=7,676 FTE-eq.

Table All.2. Standardized potential annual working time at risk. Hours use a common 2,000-hour denominator. Totals are analytical exposure equivalents, not estimates of realized output or job loss.

Barcelona's denominator is an estimated 115,000 district jobs. Houston uses a published range of 64,656-71,000 jobs; differences reflect source definition and timing. Singapore's public denominator

covers over 50,000 knowledge workers and may omit some support and contractor workers, so the workforce-scale values should be interpreted as lower bounds.

5. Labor-market evidence and assumptions

The study prioritizes district-level evidence. Where district data are unavailable, metropolitan, regional or national indicators are used as proxies and identified as such. These wider measures provide context but may not describe the business district precisely - for example, a regional remote-work rate may understate flexibility in a technology cluster while overstating it for facilities, hospitality or laboratory workers within the same district.

For each location, the labor-market profile draws on evidence across the following dimensions:

- employment and company scale;
- dominant sectors and workplace types;
- the likely distribution of office, laboratory, technical, support and production work;
- physical-activity assumptions;
- remote and hybrid working;
- commuting and transport dependence;
- building and cooling characteristics;
- labor-market conditions, skills and institutional capacity.

Public evidence is supplemented by proprietary labor-market information and qualitative feedback from local Adecco Group experts. Local input is used to validate workforce profiles, identify missing worker groups or operational dependencies and contextualize issues such as attendance, field-linked work, commuting disruption, building conditions and employer responses. It is not treated as representative statistical evidence unless independently sourced.

6. Study limitations

The locations are illustrative rather than statistically representative. Buildings, workforce composition, population distribution and adaptation are held constant in the future climate analysis.

The study does not model climate-related migration, displacement or planned relocation, or resulting changes in the size and composition of local labor markets. These dynamics are discussed qualitatively as a potential longer-term labor-market consequence, particularly when interpreting the end-century scenarios.

Physical-activity shares are informed assumptions rather than measured occupational distributions, and some labor-market indicators rely on wider geographic proxies.

The heat analysis represents long-term average conditions and does not model individual heatwaves. Adaptation is discussed but not assigned a single quantified effectiveness factor. The study therefore does not predict actual company productivity, permanent job losses, GDP impacts or future local employment levels.

These limitations define the scope of the exercise rather than remove its value. The analysis is intended to demonstrate a structured method for linking physical climate signals with workforce exposure, operational dependence and labor-market capacity to adapt.

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