

#01
JULY 26

URBAN LINES

Designing
urban comfort



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ABOUT PEOPLE

Urban planning is approached here through reflection, not as a manual, but as an evolving practice shaped by context. It offers a personal and professional point of view shaped by our work in the fields of energy and environmental engineering. I, the main author, contribute from a technical and environmental perspective, while Julien L'Hoest, a consulting engineer with over 20 years of experience, adds valuable insight drawn from his long-standing practice.

This book draws primarily on our professional experience in Luxembourg, a context we know well. While grounded in this setting, the reflections developed here are not intended as universal prescriptions and may nevertheless resonate beyond national borders.

Bioclimatic comfort is a complex and often subjective matter. For engineers, it is challenging to define clearly, let alone measure accurately. In outdoor environments, a wide range of variables influence how people perceive and experience comfort. This unpredictability is central to our discussion. Much like the well-known butterfly effect, a small change in Esch can, in theory, lead to a storm in Clervaux.

Despite this complexity, we believe that some principles can objectively improve the comfort of urban spaces. These ideas can be applied at various stages of a project, whether in the early phases of district planning or during later redevelopment efforts. With this book, we hope to share useful insights and spark reflection on how cities can be designed to better serve their inhabitants.

Thomas Löffler



TEAM

Julien L'Hoest



Consulting engineer based in Luxembourg and partner at Energie et Environnement S.A., bringing solid, hands-on experience in the building sector. He supports sustainable construction projects ranging from individual buildings to neighbourhood-scale developments, with the pragmatic and technical vision of an engineer who understands how cities are actually built. Multidisciplinary expert and co-author, he enjoys connecting energy performance, environmental quality and realistic planning, always with the quiet satisfaction of knowing that an engineer can think big... while keeping both feet firmly on the ground.

Baptiste Guelorget



Engineer by training and independent entrepreneur, he is far more inspired by action than by office walls. Combining technical expertise with a hands-on mindset, he channels his creativity into illustrating ideas, making complex concepts tangible and easy to grasp. As the book's partial illustrator, he brings engineering rigour and inventive flair together, proving that good ideas often emerge where theory meets movement.

Six axes of urban comfort



Imagine a quiet public square on a warm afternoon. The air carries the gentle sound of a fountain, voices blend easily without strain, and a few trees offer just enough shade. You feel comfortable without thinking about the details that make it so.

Urban comfort works through several dimensions. **Acoustic comfort** is not just about reducing noise, but about creating a sound environment that helps people focus, relax, or talk at ease. **Visual comfort** comes from balanced light, clarity, and a sense of harmony that makes a space pleasant to navigate. **Comfort of use** is the physical ease of being there, supported by clean surroundings, safe paths, and seating that feels natural to use. **Sensory comfort** draws on smells, textures, and materials that quietly influence how we feel. **Social comfort** is shaped by how welcome and included we feel, whether alone or in company. **Bioclimatic comfort** is the subtle balance of sun, shade, breeze, and warmth that keeps the body at ease.

When these layers are considered together, a public space becomes more than functional. It becomes a place where people naturally want to linger.



What shapes bioclimatic comfort ?



Picture yourself stepping out into the cool air of a spring morning. The air is fresh, but not cold enough to send you back inside. Light filters through the leaves, shifting gently as the wind moves. Nothing feels too harsh. The space feels balanced.

This is comfort, and it is fragile.

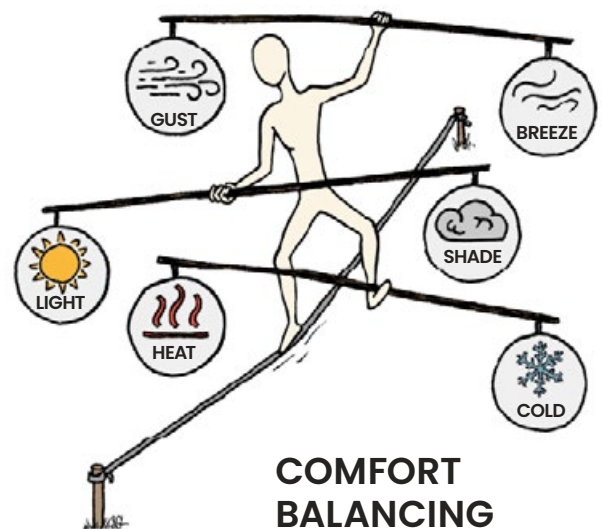
Outdoor comfort is shaped by four key elements: light, wind, temperature, and radiation. Each can make a place pleasant or uncomfortable, and they constantly interact. A warm day feels different in the shade. A light breeze can feel refreshing, until it turns into a gust.

This balance is never fixed. It changes with the hour, the season, and the weather. A space that feels perfect in the morning may feel too exposed by the afternoon.

No amount of planning can make these factors disappear. Even the most thoughtful bioclimatic design can only tilt the odds in your favour. A pergola can soften the summer sun, but it cannot erase the heat of a midsummer afternoon. A windbreak can calm a breeze, but not silence a winter storm.

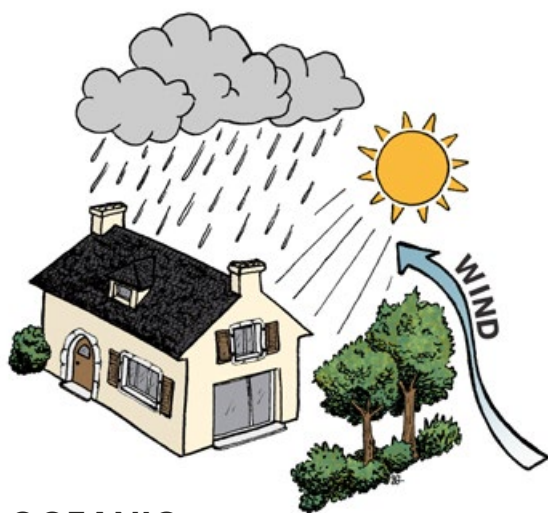
The goal is not perfection. It is to shape the space so that, most of the time, the balance of light, wind, temperature, and radiation stays within a range that feels good.

The rest is left to the seasons.



A priority issue

Climate shapes the way we design for comfort. The principles remain the same: balance sun, wind, and temperature. The priorities, however, shift with local conditions. The following examples do not cover every climate, but they show how design responses can adapt.



OCEANIC



MEDITERRANEAN

In **oceanic climates**, such as those along the Atlantic coast, rain is frequent and the sky often overcast. When it is dry, the wind is still a constant companion, and sunshine can be scarce. Comfort strategies focus on sheltering from the wind and making the most of available light.

In **Mediterranean climates**, heat dominates. Paradoxically, visitors still want to enjoy the sun, which means allowing solar access without causing overheating. Strong seasonal winds such as the Mistral can make wind protection just as important as the overheating problem. Traditional villages in southern France often reveal this balance: narrow, winding streets and tightly built houses that block the wind while casting deep shade.

In **northern continental climates**, winters are long, cold, and dark, while summers can be sunny and bright. The goal is to capture as much light and warmth as possible in winter, and to provide shade and ventilation in summer.

These examples show one clear idea. Comfort comes from working with the climate, not against it. The same public square will be designed differently in Marseille, Brest, and Warsaw, and each will feel right in its own way.

Urban design is essential, yet it cannot be expected to master every climatic nuance alone. Even the most thoughtful layouts have limits, meaning technical or temporary solutions can be necessary to bridge the gap. Through interventions such as solar shading, windbreaks, or other similar measures, these tools provide the flexibility that permanent architecture may not always achieve.



Climate context & classification

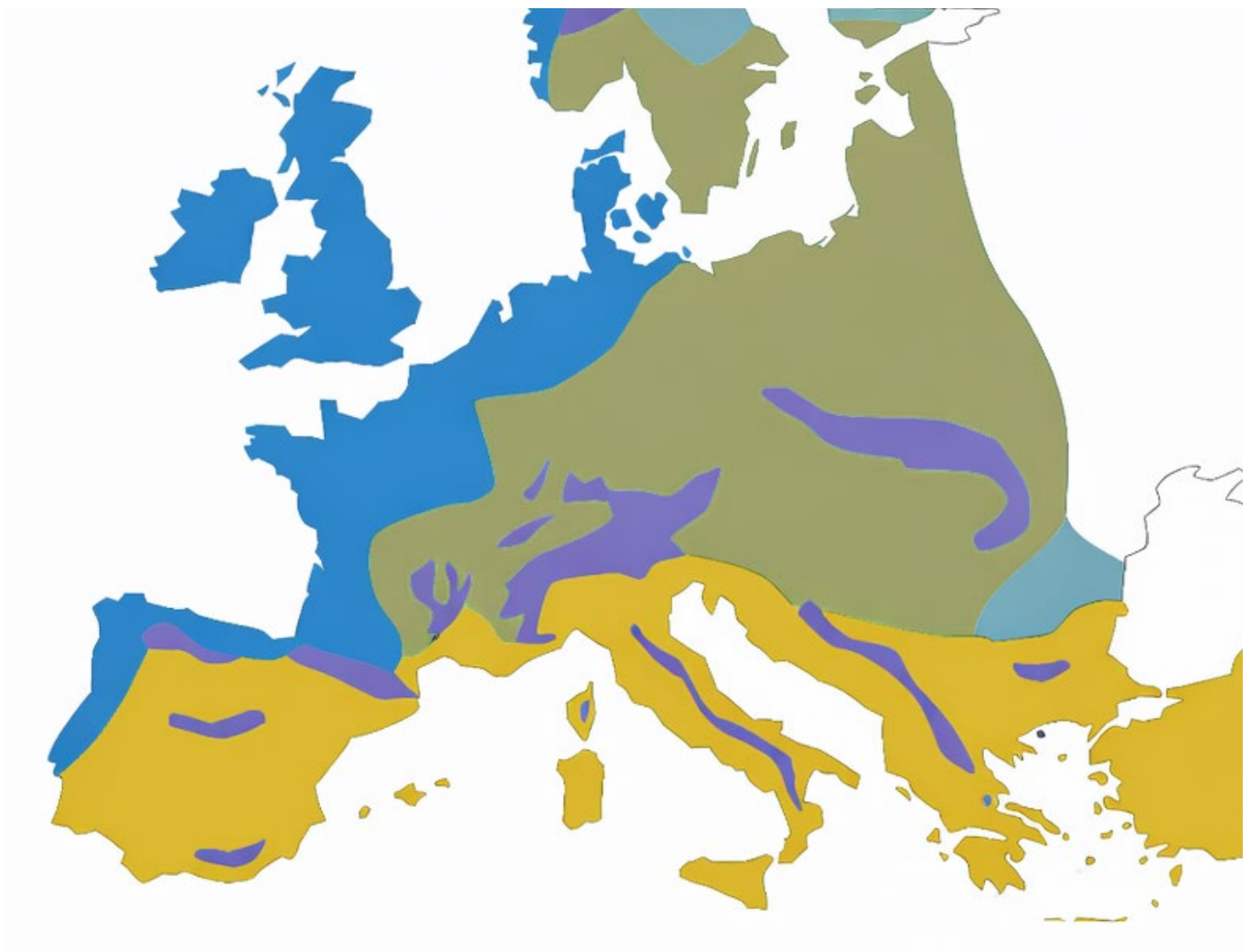


Climate Classification

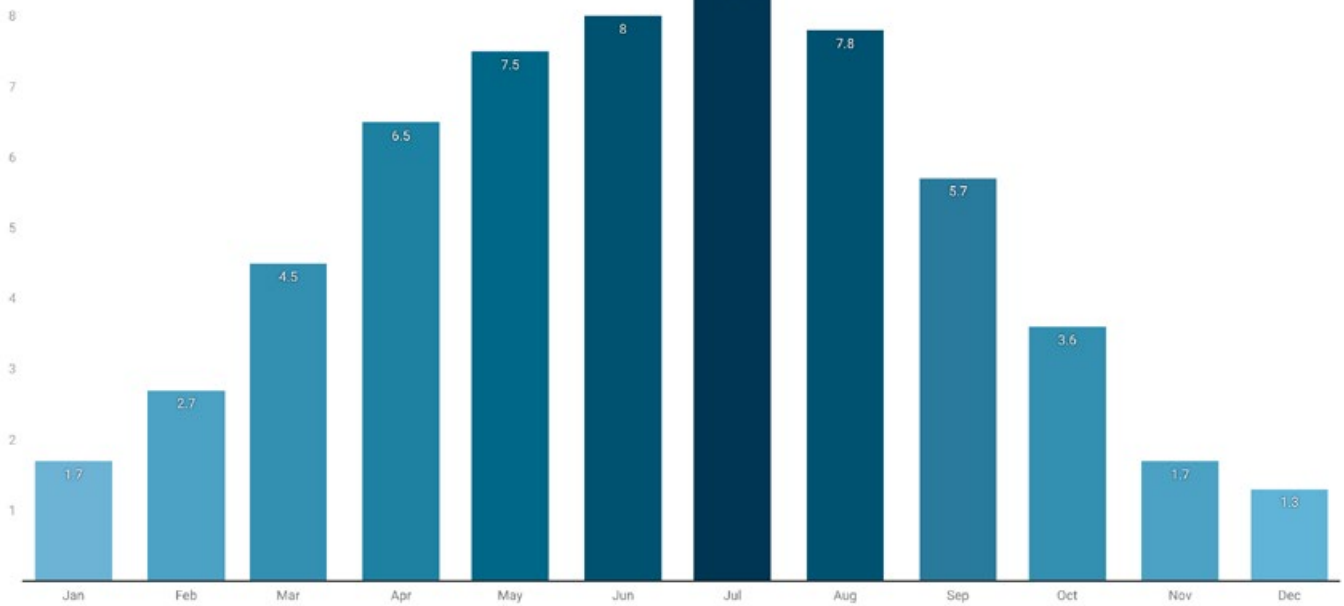
These maps highlight the main European climate types and their typical characteristics. However, climate classification alone is not sufficient to define design strategies. Local conditions such as wind exposure, solar access, and daylight availability can vary significantly within the same climate zone.

For instance, the oceanic climate extends from Portugal to Norway, yet the design challenges differ greatly due to changes in latitude, prevailing winds, and luminosity. Climate types therefore provide a general framework, while site-specific conditions remain the decisive factor.

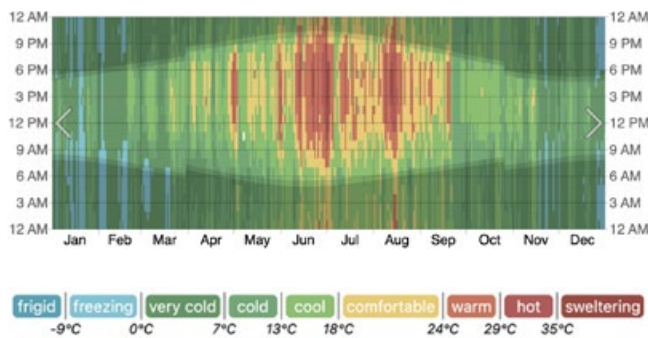
-  **Oceanic**
-  **Semi-continental**
-  **Continental**
-  **Mediterranean**
-  **Mountain**



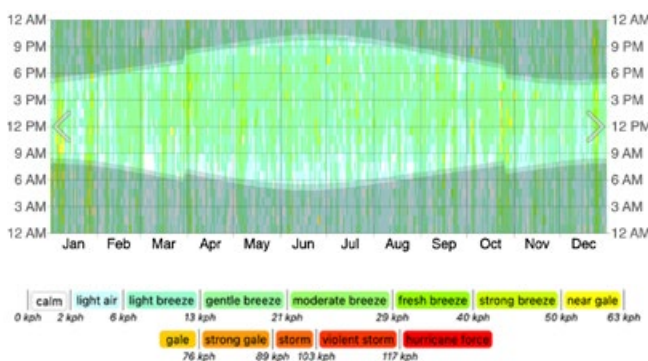
DAILY HOURS OF SUNSHINE



**Four distinct seasons...
sometimes in the same week.**



Luxembourg typically experiences a **temperate, semi-continental climate**, marked more by moderation than by extremes. Winters are generally mild rather than severe, and summers remain relatively gentle, although episodes of intense heat have become more frequent and more pronounced in recent years. Winds are usually weak to moderate, reinforcing this overall sense of climatic “average.”



One feature that deserves closer attention is the sometimes significant diurnal temperature range between day and night. This daily amplitude is particularly relevant for bioclimatic building design, as it can strongly influence thermal comfort and energy strategies. It should be noted, however, that this effect is often attenuated in dense urban environments, where the urban heat island smooths out temperature variations.



Priorities & urban heat island

Heat balance priorities in Luxembourg's semi-continental climate

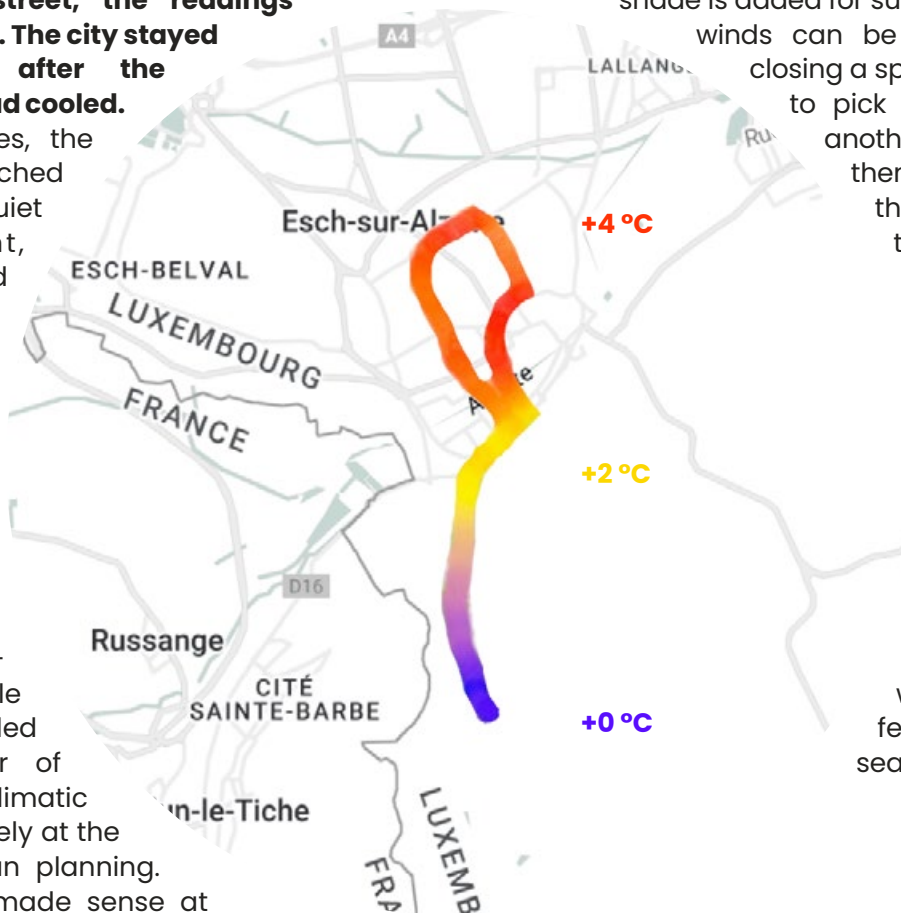
One summer night in Esch, a research team set out to measure what the day had left behind. They drove slowly through the streets, a temperature probe fixed outside the car to capture the air untouched by the vehicle's own heat. Street after street, the readings drew a pattern. The city stayed warm, long after the countryside had cooled.

In some places, the difference reached 4°C. It was a quiet measurement, but it revealed something large. And the projections are clear: by 2050 to 2100, that gap may grow by another 2 to 3 degrees.

Until recently, few people would have called this a matter of comfort. Bioclimatic design was rarely at the centre of urban planning. Perhaps that made sense at the time. The climate felt stable, and cities grew piece by piece, each building making its own compromises. Now, entire districts are planned at once, and the climate is shifting fast. This creates a rare moment to think about comfort as a whole, not as an afterthought.

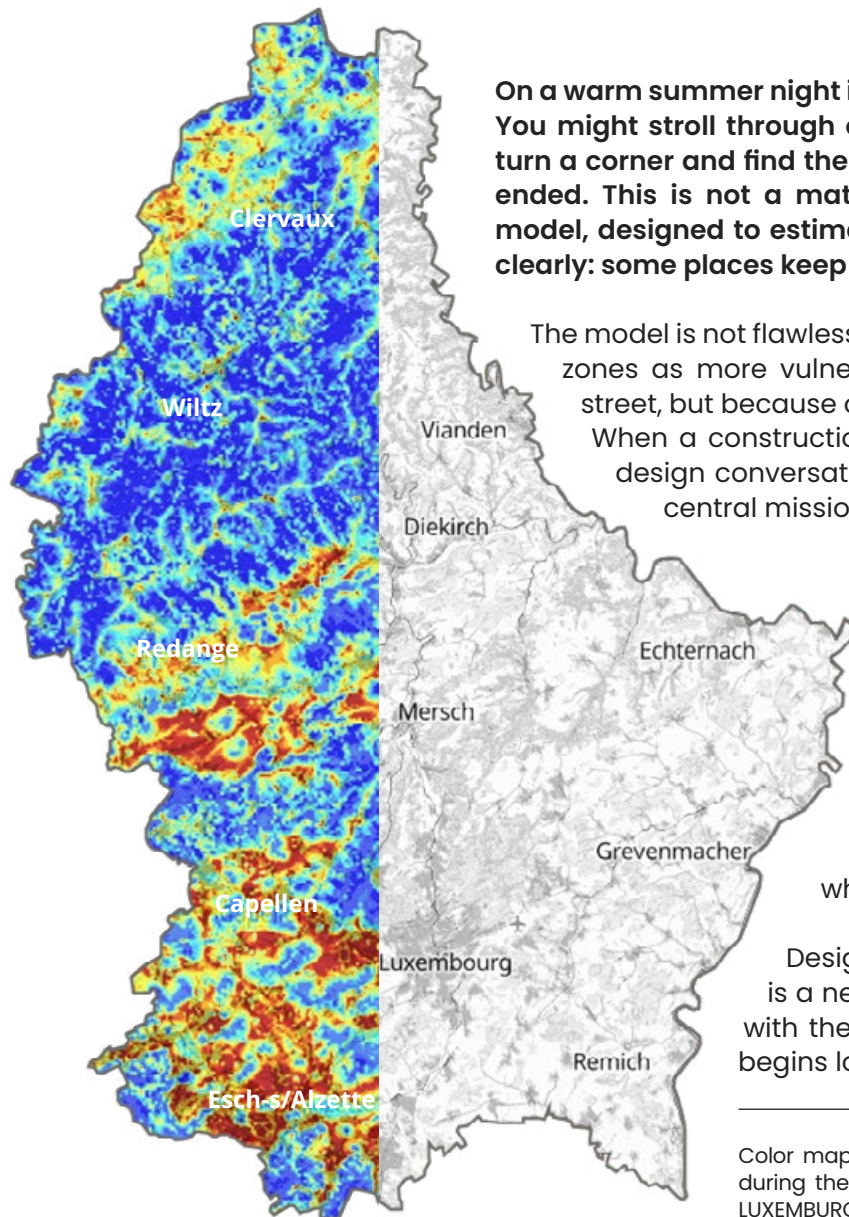
That moment comes with choices. The heat island is the primary challenge because it shapes the conditions for all the others. But this is not an argument for ignoring light, wind, or seasonal balance. Winter sun can be preserved, even as shade is added for summer. Mid-season

winds can be softened without closing a space. The aim is not to pick one comfort over another, but to weave them into a hierarchy that reflects both the data and the way people live. In our case, the evidence points to heat as the leading concern, yet the other elements remain part of the design. The goal is simple: a city that will stay livable as it warms, and still feel good in every season.



Junk J, Lett C, Trebs I, Hipler E, Torres-Matallana JA, Lichti R, Matzarakis A. Quantifying the Effects of Climate Change on the Urban Heat Island Intensity in Luxembourg—Sustainable Adaptation and Mitigation Strategies Through Urban Design. *Atmosphere*. 2025; 16(4):462. <https://doi.org/10.3390/atmos16040462>

Case : Luxembourg



On a warm summer night in Luxembourg, the air feels strangely uneven. You might stroll through one part of the city and breathe easily, then turn a corner and find the heat clinging to your skin as if the day never ended. This is not a matter of perception. A countrywide numerical model, designed to estimate nighttime air temperatures, has shown it clearly: some places keep the warmth long after sunset.

The model is not flawless, but it tells a compelling story. It marks certain zones as more vulnerable, not because of any single building or street, but because of how the surroundings trap and release heat. When a construction project falls within one of these zones, the design conversation changes. Cooling the space becomes the central mission.

At that point, we found it useful to impose a kind of hierarchy on the bioclimatic problem. The first priority is to prevent the formation of heat islands. The second is to moderate wind in the mid-seasons while still allowing enough light in winter. Yet this ordering should not be mistaken for exclusivity: giving primacy to one concern does not mean the others can be neglected. Rather, it clarifies where to begin when trade-offs are unavoidable.

Design, in this sense, is not an abstract exercise. It is a negotiation with the climate's habits, a dialogue with the air itself, and a way of shaping comfort that begins long before the walls are drawn.

Color map: PET thermal load (physiological equivalent temperature) during the day (14 hours) - Study : KLIMAÖKOLOGISCHE SITUATION IN LUXEMBURG – Modellbasierte regionale Klimaanalyse

Proposed hierarchy

The proposed hierarchy of priorities for Luxembourg is as follows: first, addressing the risk of urban heat islands (which is increasing due to global warming). Second, the goal is to promote access to natural light and limit uncomfortable wind risks, without compromising the primary objective.

PRIMARY OBJECTIVE



URBAN HEAT ISLAND

SECONDARY OBJECTIVES



WIND CONTROL

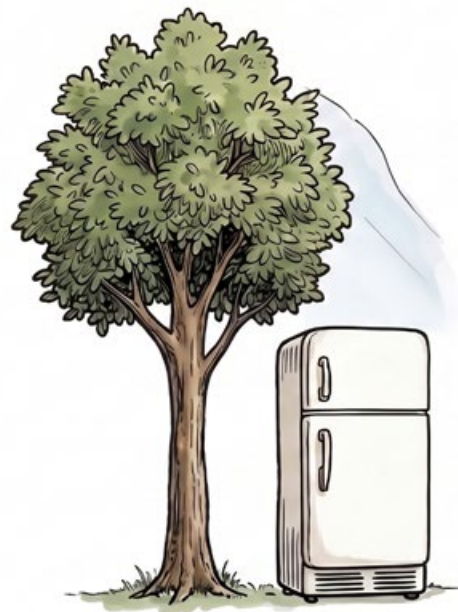


LIGHT ACCESS



Wind: 4m/s = -5°C
(Removing a sweater)

5



Shade = -16°C
(Entering a fridge)

16

Yahia, M.W., Johansson, E., Thorsson, S. et al. Effect of urban design on microclimate and thermal comfort outdoors in warm-humid Dar es Salaam, Tanzania. *Int J Biometeorol* 62, 373–385 (2018). <https://doi.org/10.1007/s00484-017-1380-7>

Heat island

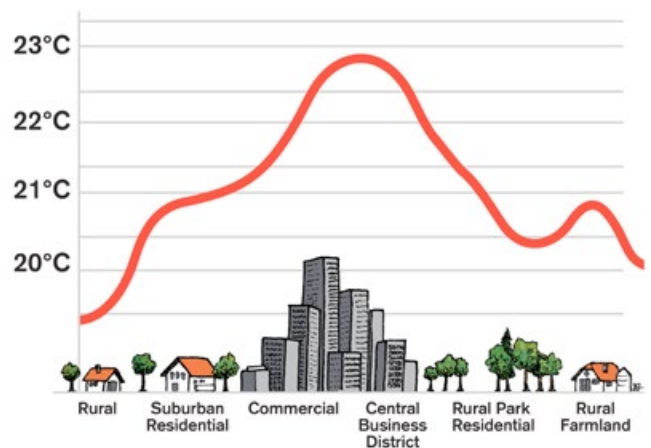
Heat islands are not just about air temperature. Your body senses heat as a mix of the air around you and the warmth radiating from surfaces. That is why a hot pavement, a sunlit wall, or direct sunlight in summer can feel far hotter than the thermometer suggests.

Wind helps, but often less than shade. In one study from a hot city in Tanzania, a steady breeze made conditions feel about five degrees cooler, while shade reduced perceived heat by up to sixteen degrees. Shade is more than the absence of sun; it blocks radiant heat. And in low latitudes, tall buildings often fail to provide midday shade when the sun is overhead, while trees do.

Fighting heat islands, then, is not only about air-flow or cooler materials. It is about how people actually experience heat, and how something as simple as shade can transform the city.

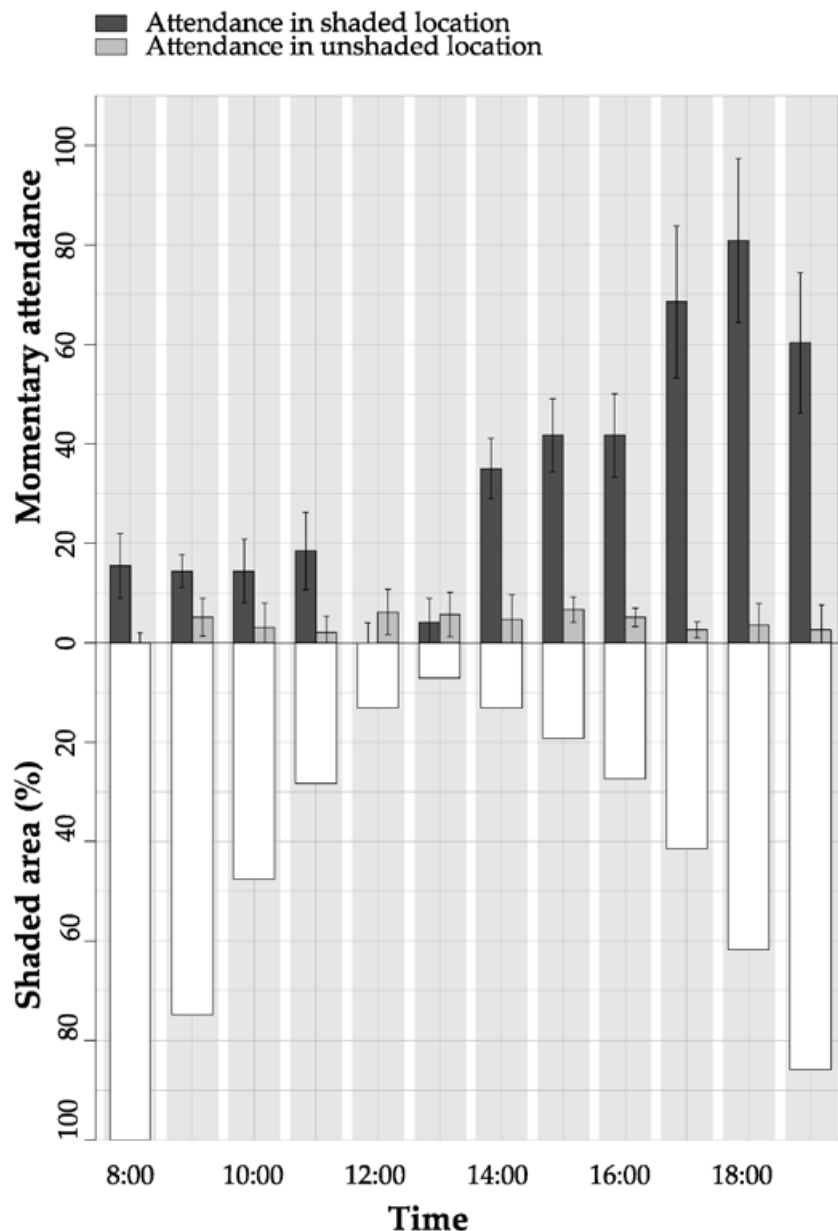
Urban heat island profile

Temperatures after sunset



Heat island & direct solar radiation





Laureti, F.; Martinelli, L.; Battisti, A. Assessment and Mitigation Strategies to Counteract Overheating in Urban Historical Areas in Rome. *Climate* 2018, 6, 18. <https://doi.org/10.3390/cli6010018>

Our primary target is radiant heat from the sun. In cities it is the quiet engine of the heat island. Your body does not read comfort from the air alone. It adds the warmth that pours in from every surface it can see. That is why a square metre of shade can feel like a mercy, even when the thermometer has not moved.

Consider a Roman piazza at midday. Observers tracked where people chose to stand and sit across the day. The pattern looked almost like a time-lapse of a migrating species. As the shadow drifted, the crowd drifted with it. The sunlit stone remained nearly empty, not because the air was hotter there, but because the radiant load was relentless.

A simple thermal camera makes the lesson visible. Paving and facades in full sun glow in false colour, much hotter than their shaded neighbours, even

when the air temperature is identical. In direct sun the mean perceived temperature can rise by about ten to fifteen degrees Celsius. That single change can add roughly five to eight degrees to perceived heat. Shade, therefore, is not an aesthetic preference. It is the most direct way to lower what the body actually feels.

Design follows from this logic. Start by blocking the sun where people linger and move. Let canopies, trees, and cool surfaces do the heavy lifting. Air movement can help, but without shade it is a consolation prize. In the struggle against urban overheating, the first victory is won in the radiant field.

The ground and nearby walls, having absorbed heat all day, quietly release it back into the air. This radiant warmth is what your body notices most, an invisible glow that seeps into the skin long after daylight has gone.

If the problem begins with surfaces, so does the solution. Walls offer little room for change, but the ground is more forgiving if we choose it carefully. Material matters. A lighter surface reflects sunlight instead of swallowing it. A surface with low thermal inertia behaves like a pan that cools as soon as it leaves the stove. It does not cling to the day's heat, and so it spares us the lingering warmth of the evening, just when relief is most needed.

Shade is the next move. Prevent the ground from heating in the first place and the problem shrinks before it begins. Overhead structures, pergolas, arcades and the quiet geometry of trees all interrupt the sun's path. The result is not only cooler air but a dramatic drop in the radiant

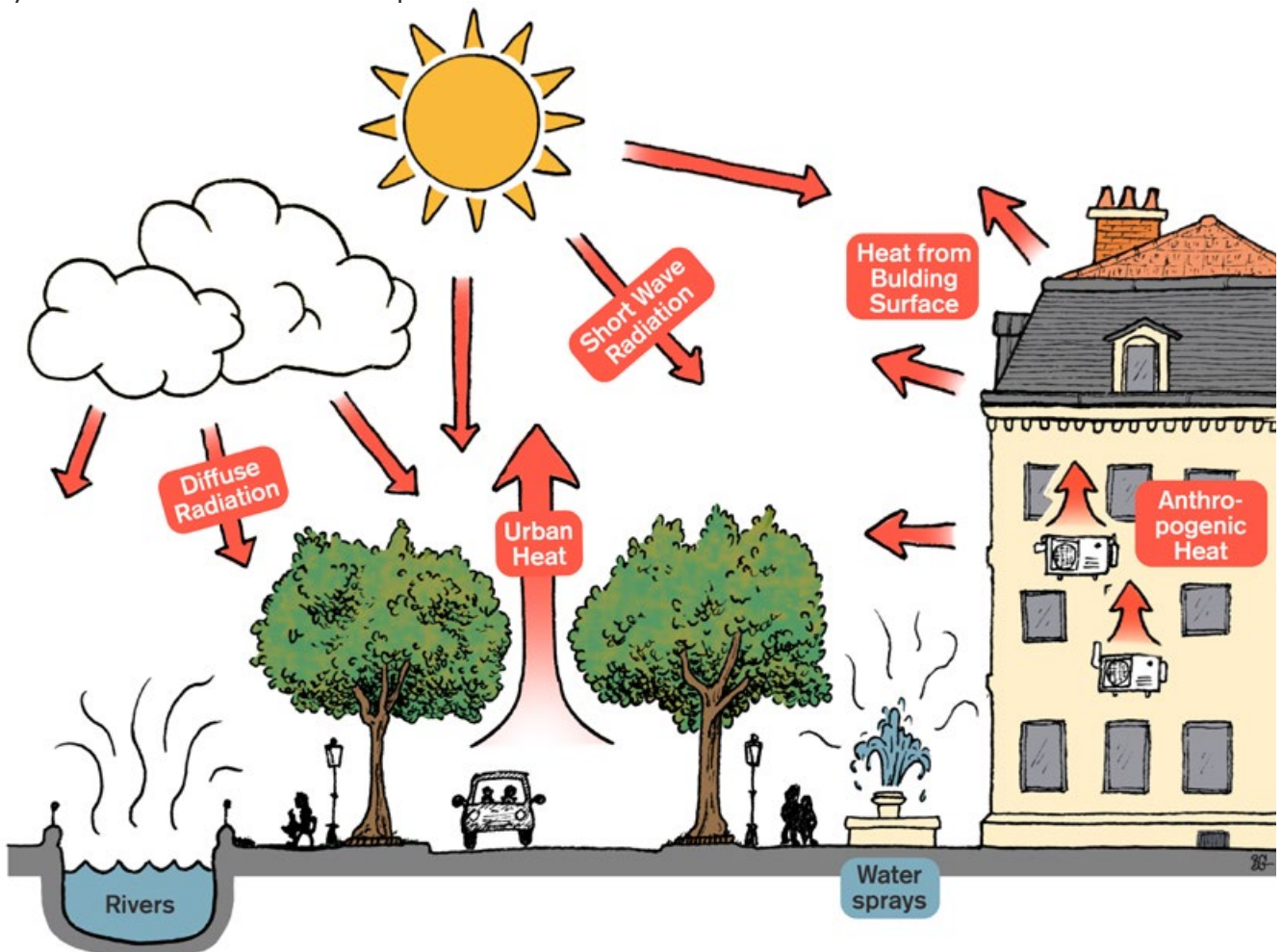
load that makes a square feel unwalkable at dusk.

Vegetation transforms the remaining energy in a different way. Plants spend sunlight on evaporation. Through evapotranspiration they often divert a large share of the incoming energy, sometimes around half, into water vapour rather than heat.

What would have become a hot surface becomes a cool microclimate. The air feels softer, the paving stops burning through shoes, and the evening finally belongs to people again.

Design for comfort is therefore a sequence of small, rational choices that compound. Choose ground materials that do not store heat. Keep the sun off the surfaces that people touch and cross. Invite plants to move energy out of the thermal ledger. None of this is dramatic, yet together it rewrites the nighttime experience of a street or a square, turning radiant glare into something closer to calm.

What lingers at night is not the sun itself, but its memory

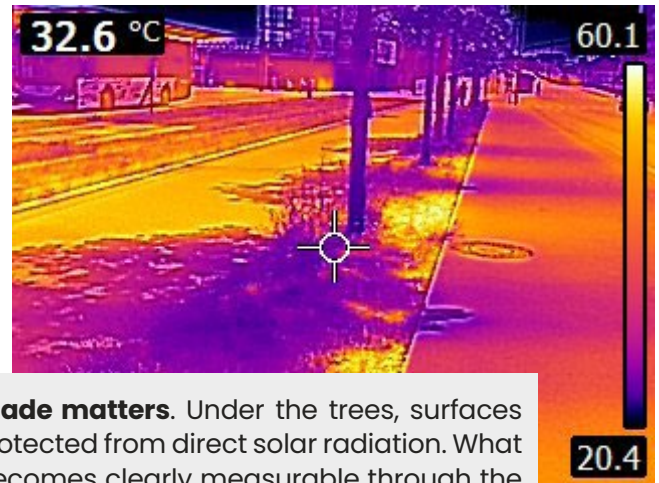


Comparative simulation

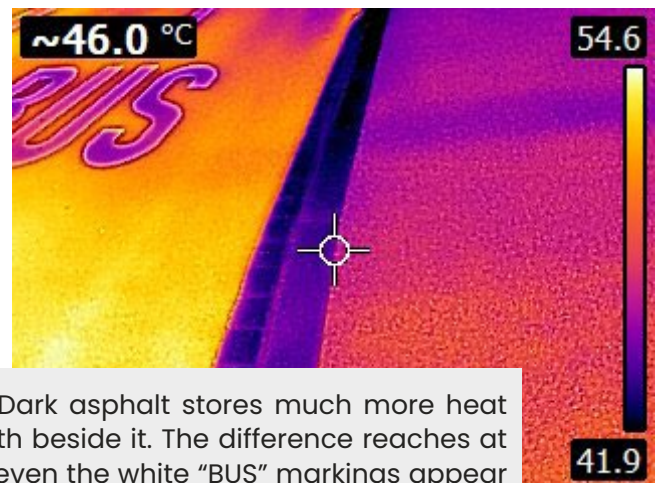
A thermal camera makes surface temperature differences immediately visible. These images were taken on a sunny day in Luxembourg-Gare and show how materials, colour, shade and vegetation influence outdoor comfort.



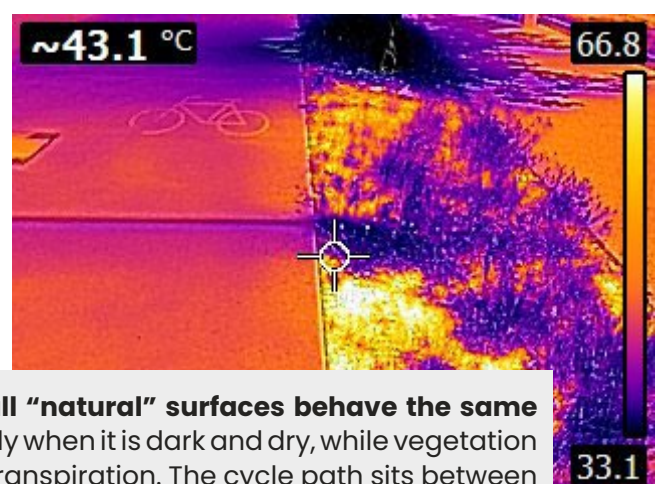
The first lesson is almost immediate: **shade matters**. Under the trees, surfaces remain visibly cooler because they are protected from direct solar radiation. What we usually feel intuitively on a hot day becomes clearly measurable through the thermal camera.



Surface colour also plays a major role. Dark asphalt stores much more heat than the lighter pedestrian and cycle path beside it. The difference reaches at least 10°C, and the effect is so clear that even the white "BUS" markings appear cooler than the surrounding road.

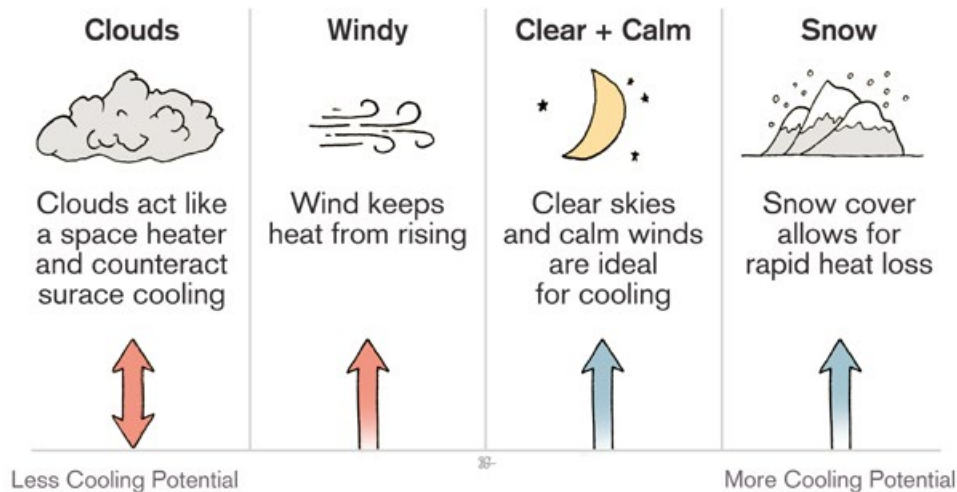


The last comparison shows that **not all "natural" surfaces behave the same way**. Bare soil heats up quickly, especially when it is dark and dry, while vegetation remains much cooler thanks to evapotranspiration. The cycle path sits between the two: warmer than grass, but less heat-absorbing than dark soil.



On clear summer nights, the ground cools itself by radiating heat towards the cold sky. It is a silent exchange. When clouds appear, they act like a blanket and reduce this cooling. Strong winds weaken it too, by mixing the air. Snow, on the contrary, enhances it.

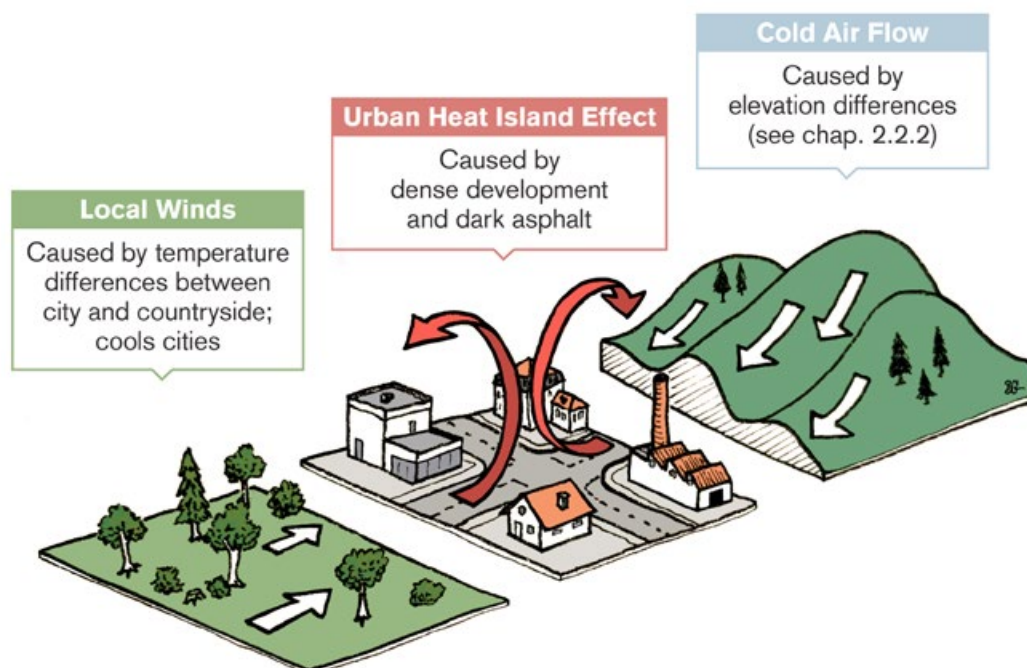
RADIATIONAL COOLING



This is why open plains often cool more efficiently than forests. Trees limit the view of the sky and trap heat within the canopy.

In calm conditions, the air cooled near the ground becomes denser and begins to flow. It moves downslope, from mountains towards valleys, from rural plains towards warmer cities. It follows gravity and natural topography.

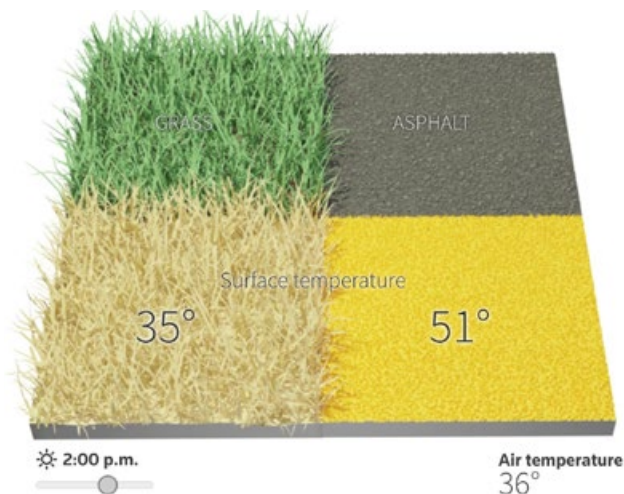
Cities, however, rarely cool as efficiently. Their materials store heat, and their geometry limits exposure to the sky. The nightly reset is incomplete. What remains is a subtle imbalance between surface, air, and sky.



Turning sunshine into water

Grass behaves very differently from concrete. Between 50 and 70 percent of the solar energy it receives is converted into evapotranspiration rather than heat, dramatically limiting surface temperature. In doing so, a turfgrass lawn can evapotranspire roughly 2 to 5 litres of water per square meter per day, quietly dissipating 1,4 to 3,5 kWh of energy. An enormous amount, exchanged with the atmosphere.

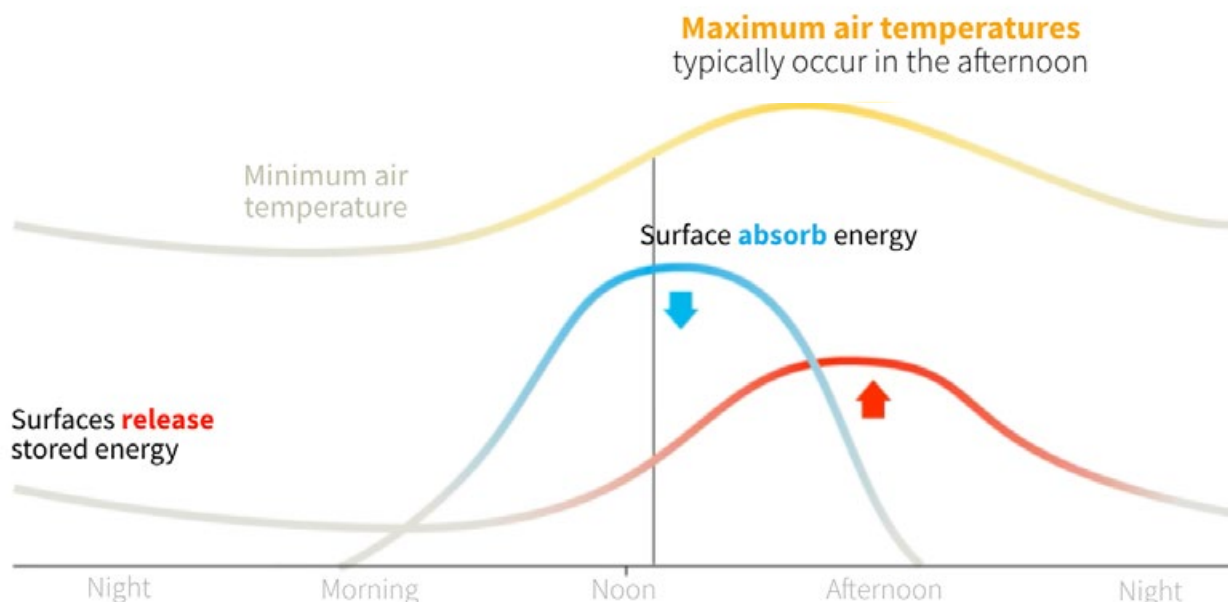
Mariano Zafra, "How concrete, asphalt and urban heat islands add to the misery of heat waves," Reuters, 1 July 2025.



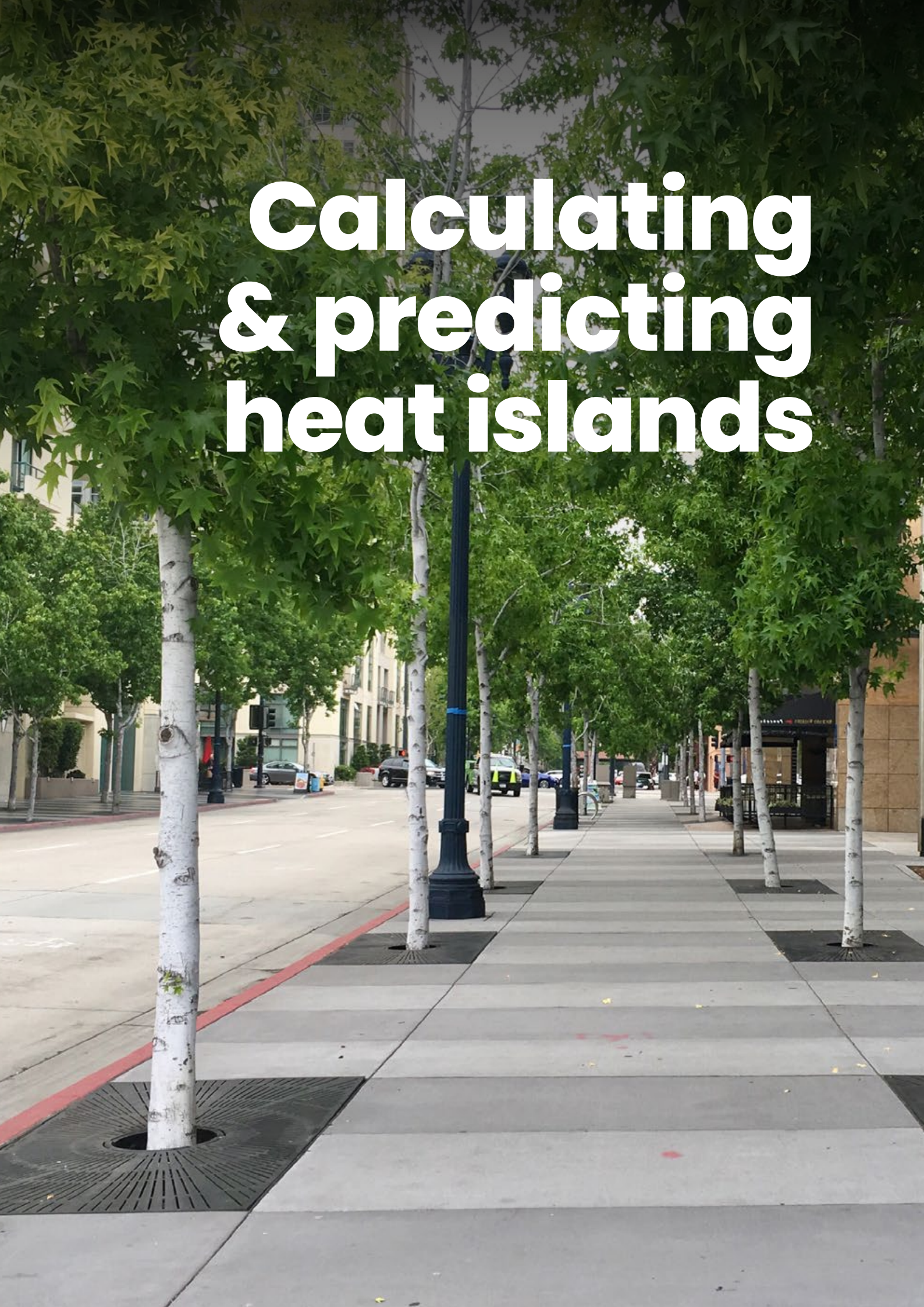
Cities act as accumulators

The graph below illustrates something we both quantify and intuitively experience. High-inertia materials such as concrete and asphalt absorb substantial amounts of solar energy throughout the day. Rather than releasing it immediately, they store it and return it later, with a noticeable time lag, during the evening and night. This delayed release can be advantageous in certain climates or seasons. In dense urban environments, however, it often becomes burdensome.

Even after sunset, surfaces continue to emit the heat accumulated hours earlier, sustaining elevated air temperatures and reinforcing the impression that the city never truly cools down. The result is not just warmer measurements, but a persistent feeling of heaviness that defines many urban nights.



Calculating & predicting heat islands



Outdoor climate modelling starts with simple static simulations to compare surface materials and shading. These quick studies are ideal for early design, as what matters is not absolute temperature but relative improvement versus a baseline.

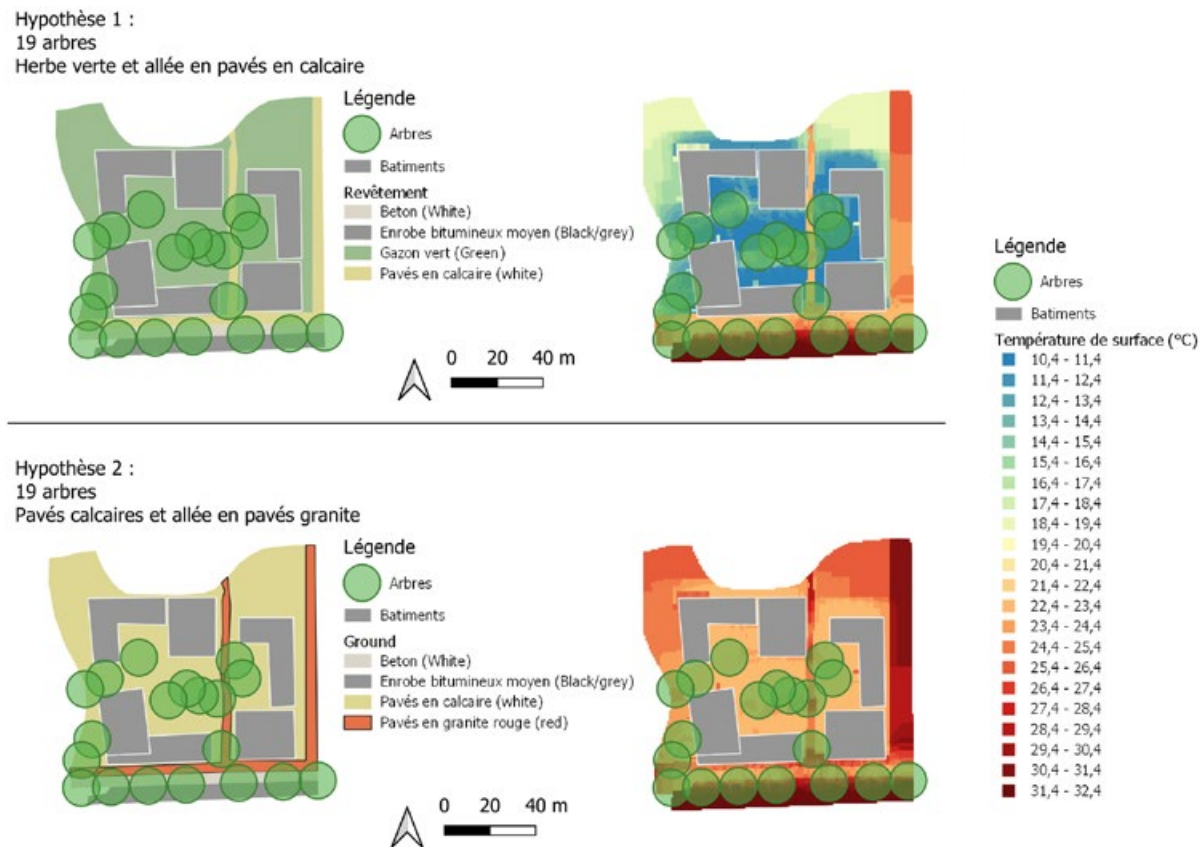
More advanced dynamic simulations add weather, wind, and radiation, but cities are complex open systems and results depend heavily on assumptions and selected moments. Comfort indices like UTCI or PET are useful for spotting trends and hot spots, not for exact predictions.

At human scale, comfort is strongly influenced by movable shade, vegetation, and ground thermal behaviour, which are hard to capture in a single

snapshot. What looks uncomfortable in a model may feel fine with simple design interventions.

The key is not model complexity but scenario selection. Comparing designs across a few representative situations reveals robust patterns: lighter materials cool surfaces, shade reduces radiant load, and vegetation improves comfort through evaporation.

These tools are best used to compare options, communicate assumptions clearly, and guide design through relative gains rather than precise forecasts.



Study carried out by Energie et Environnement S.A. within the framework of a project, focusing on surface temperatures as a function of ground covering materials.

Perceived temperature predicting and optimization



The thermometer measures air temperature. The body experiences something more complex. Sun, warm surfaces, wind and humidity combine to determine how hot or cool an outdoor space actually feels.

The Universal Thermal Climate Index (UTCI) translates these effects into an equivalent outdoor temperature, expressed in °C. Because it is based on the human heat balance, it describes pedestrian-level thermal stress more meaningfully than air temperature alone.

UTCI is most useful as a comparative design tool. Under identical weather conditions, it reveals how an urban layout changes exposure and where an intervention produces the greatest benefit.

It can be used to test tree and building shade, ventilation paths, vegetation and water, surface materials, and the location of benches, pedestrian routes or waiting areas.

A comparison, not a personal forecast

Clothing, activity and individual sensitivity still matter. The robust result is the relative difference between scenarios, not a single absolute value.

Adding trees: where does the cooling come from?

1

Shade + evapotranspiration

Tree cover lowers radiant exposure and cools the immediate surroundings.

2

A local trade-off

Trees reduce wind speed locally, slightly limiting convective cooling; shade can more than compensate.

3

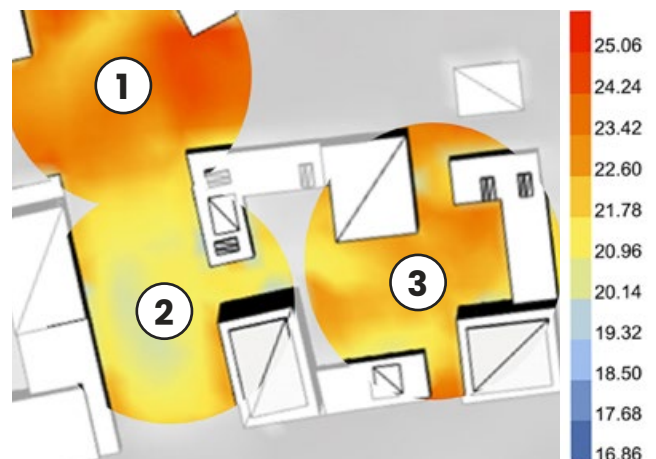
Courtyard benefit

Where the canopy blocks direct sun, the reduction in radiant load clearly improves UTCI.

Simulation assumption: representative mature plane trees introduced into the urban model



Reference scenario: without trees



Design scenario : with trees



**Secondary
objective:
wind**



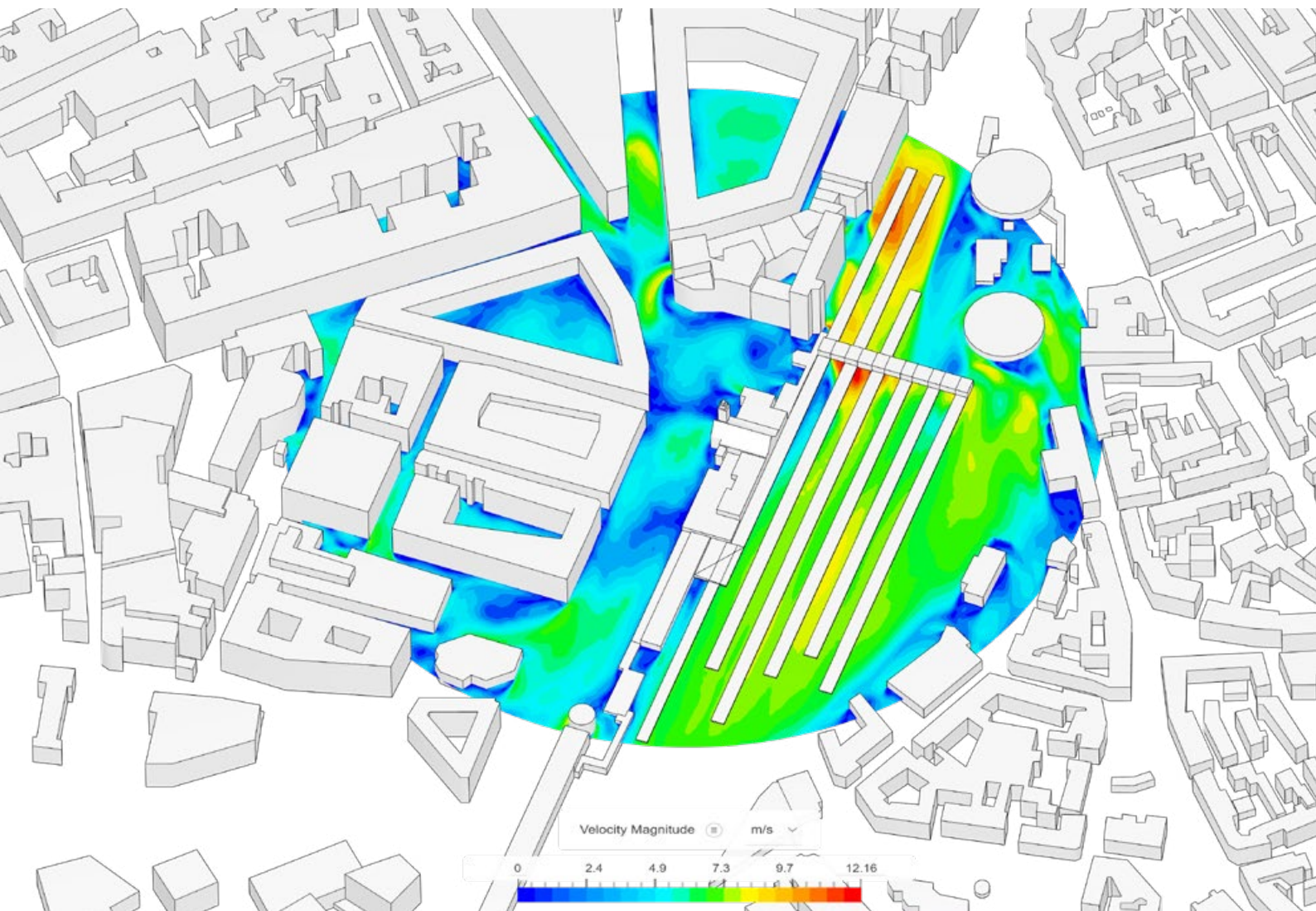
Working with the wind

A light breeze improves comfort by preventing stagnant air and limiting seasonal discomfort. Wind is therefore a secondary design objective, but a key input for comfort indices like PET and UTCI.

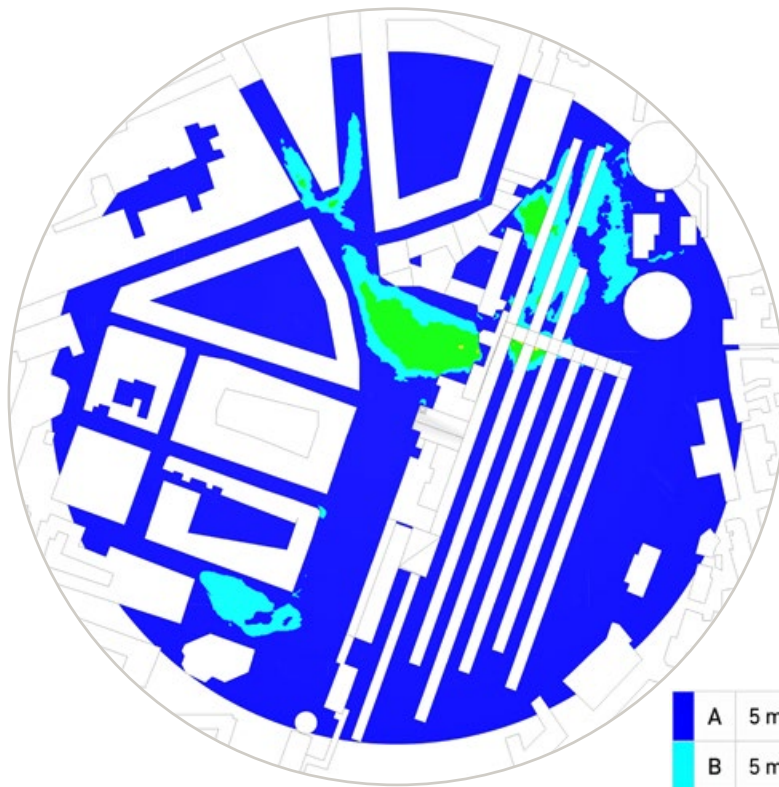
Simulation is most useful in cooler months, with trees modeled leaf-off, when exposure and complaints are highest. The goal is not precision but risk detection: downwash at towers, venturi effects between buildings, or wind acceleration at corners. If these are avoided, remaining issues are usually manageable.

The aim is not to block wind entirely. Over-protected spaces feel dead and often worsen summer comfort. A porous design, using planting and built elements as filters rather than barriers, softens gusts while maintaining airflow.

There is no universal comfort threshold. Simulations should compare options under identical conditions and focus on recurring patterns. When gusts are reduced without eliminating background airflow, the space will feel comfortable in practice, even if the metrics are imperfect.



Good urban design doesn't stop the wind. It negotiates with it.



A	5 m/s	< 2.5%	Sitting Long
B	5 m/s	< 5%	Sitting Short
C	5 m/s	< 10%	Walking Leisurely
D	5 m/s	< 20%	Walking Fast
E	5 m/s	>= 20%	Uncomfortable



Image source: Imperial's wind tunnel used for testing wind in cities and towns (Dave Guttridge)

Wind is a secondary objective but the most robust outdoor parameter to model, usually via CFD. Multiple wind directions are simulated and pedestrian-level speeds are extracted.

These speeds are combined with local wind statistics to estimate exceedance and assign comfort and safety classes. The focus is on comparison, not absolute accuracy, typically under worst-case, leaf-off conditions.

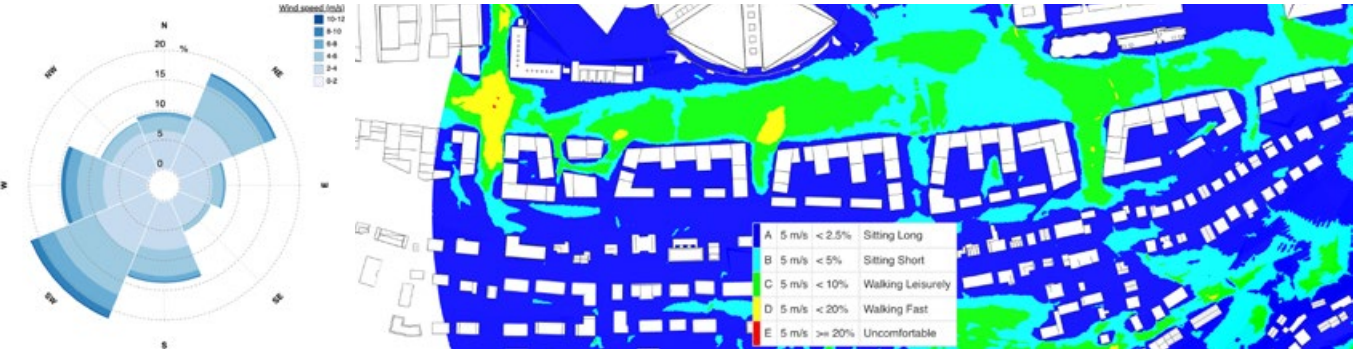
What matters is the pattern: repeated downwash, venturi effects, or accelerations reveal real design issues. A solution that reduces gusts while keeping light airflow will feel comfortable in reality, even if the numbers are not perfect.

Case : Quartier Kirchberg

Kirchberg is known for its long boulevard, where wind is frequently noticeable. This study examines a future district along this axis through three configurations.

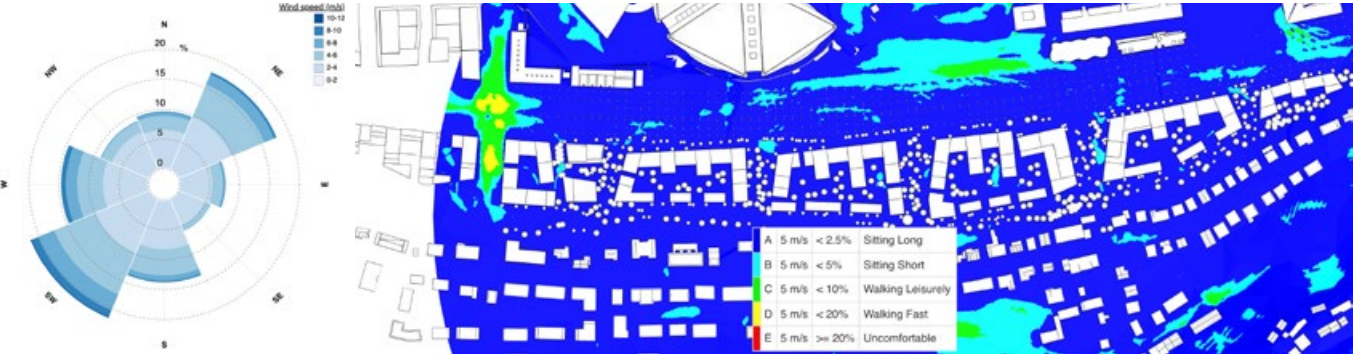
WIND LUXEMBOURG

Without trees, airflow remains largely unobstructed and may accelerate between buildings.



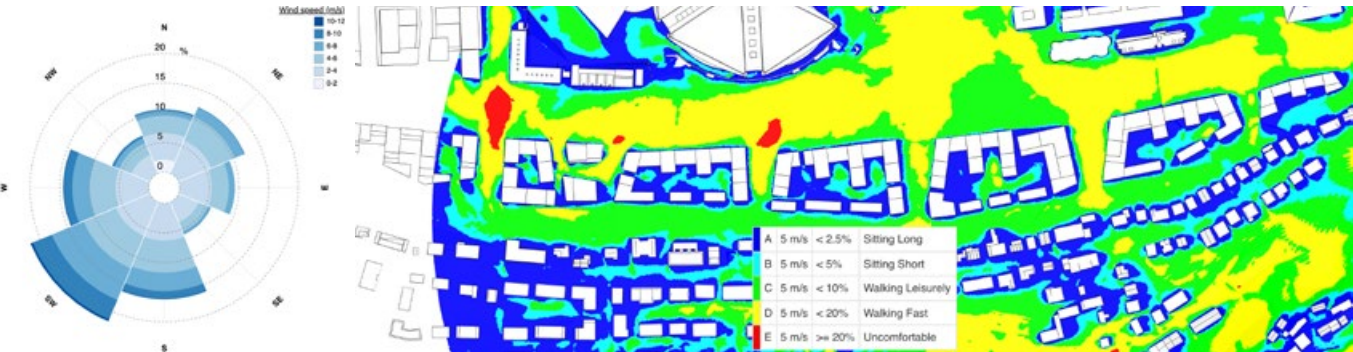
WIND LUXEMBOURG + TREES

Introducing trees, even relatively small ones, already reduces wind speeds and improves comfort.

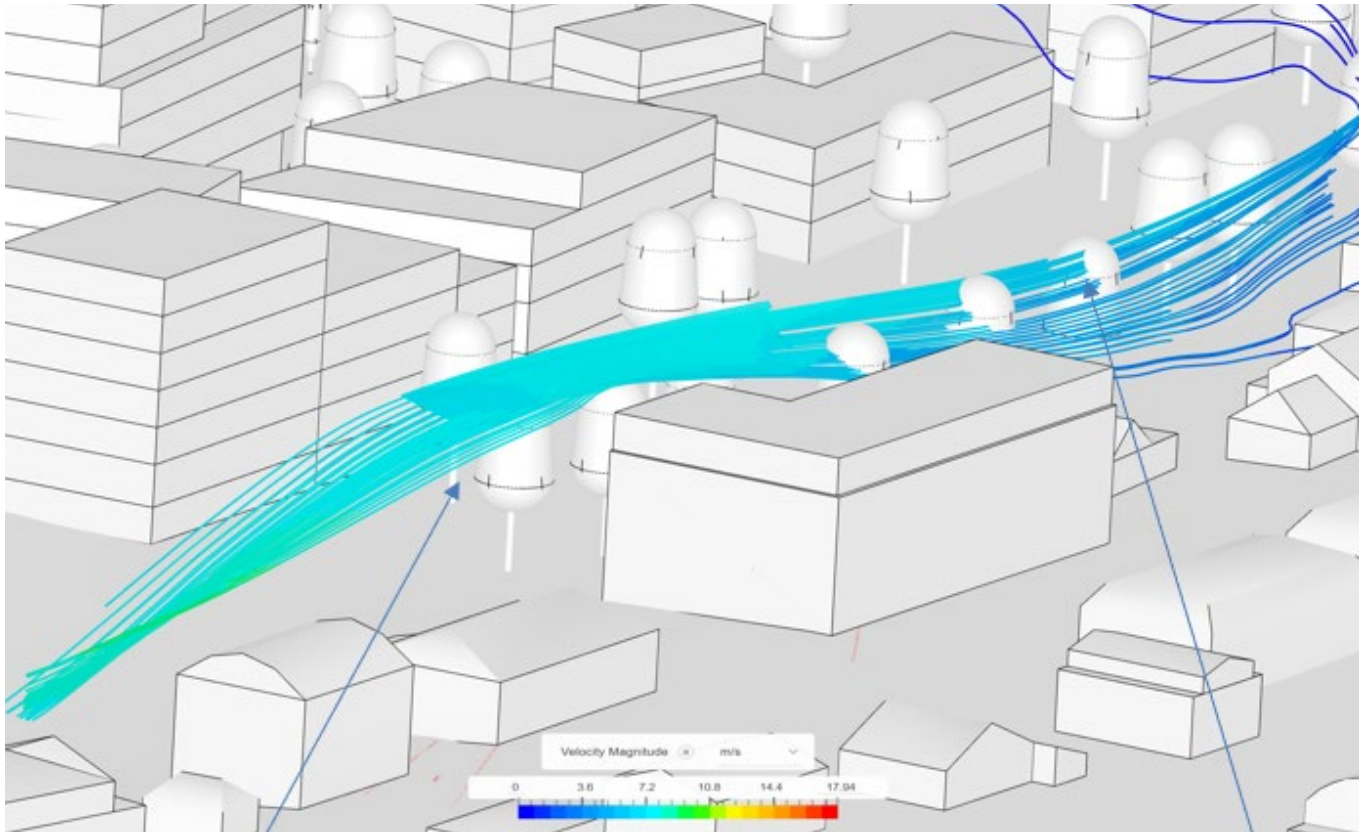


WIND ROTTERDAM

The comparison with Rotterdam's wind rose highlights that wind exposure is shaped not only by urban form, but also by the regional climate context.



Trees offer many benefits, which will be discussed further on. In strong wind conditions, the canopy helps keep the main airflow above pedestrian level, while leaves and trunks break up the current, slowing it down and making it more diffuse. The wind does not disappear, but it becomes softer and more tolerable.



Keep high winds at higher elevations

Slows down the wind



Tree trunks do slow the wind, but their effect remains limited. Young trees, or trees in winter when their leaves have fallen, provide far less protection. The absence of foliage allows more natural light to enter, which can be beneficial. Yet that same openness also lets cold winds move through more freely. When temperatures are already low, this detail becomes immediately noticeable.

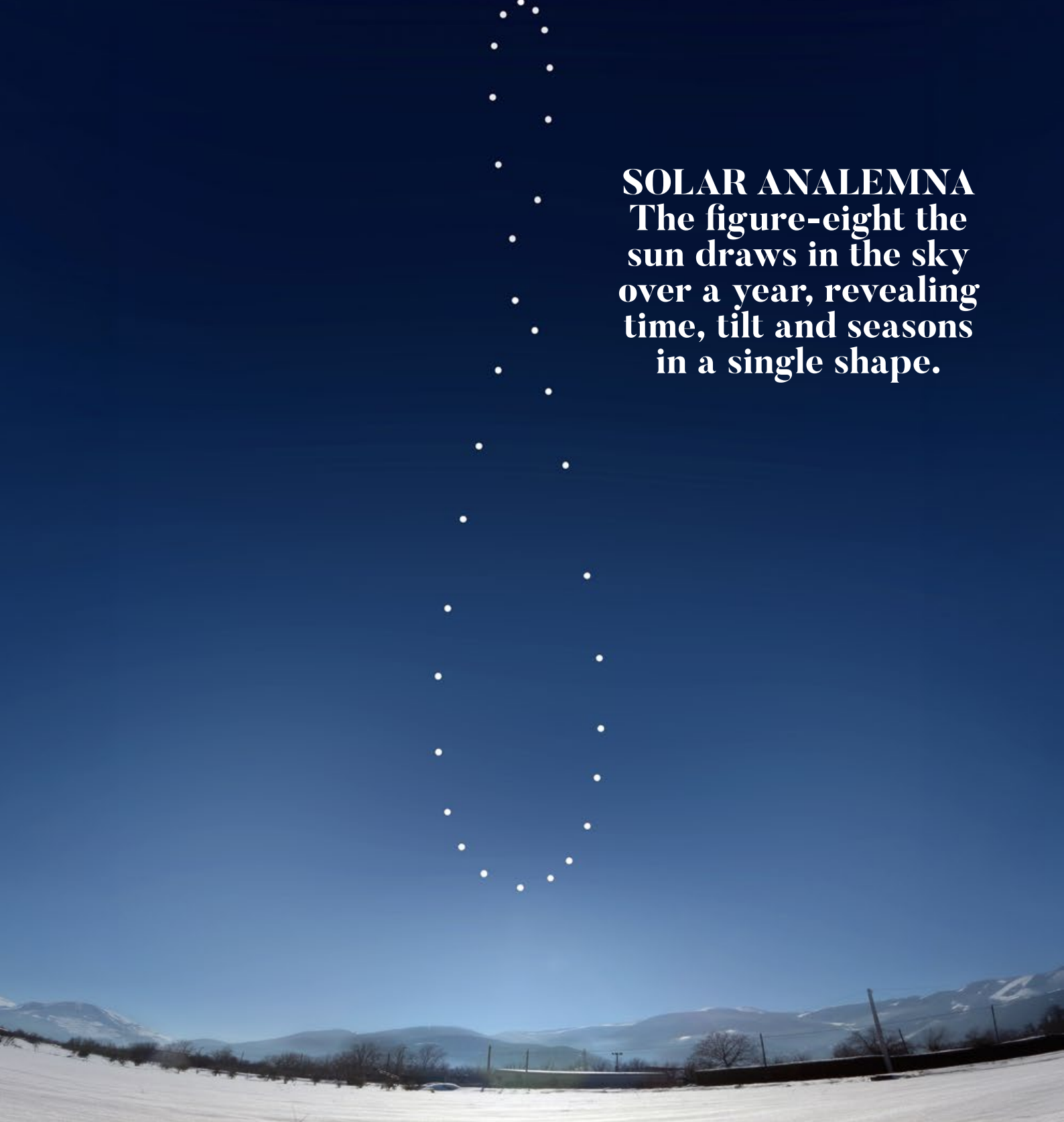


Foliage slows the wind. But for the effect to be meaningful, trees must be leafy and sufficiently dense. That density comes with a trade-off: reduced natural light. Yet shade is not always experienced as a loss. It can become a form of comfort, almost instinctive, especially when light is strong



Secondary objective: light

SOLAR ANALEMNA
The figure-eight the
sun draws in the sky
over a year, revealing
time, tilt and seasons
in a single shape.



Light : How do you calculate it & what are the criteria?

Light is perhaps the most predictable variable in our environment. The sun follows a precise path. Its position is known for every minute of the year. The uncertainty lies not in whether it shines, but in where and when it reaches people at ground level.

To understand this, we rely on several complementary assessment methods.

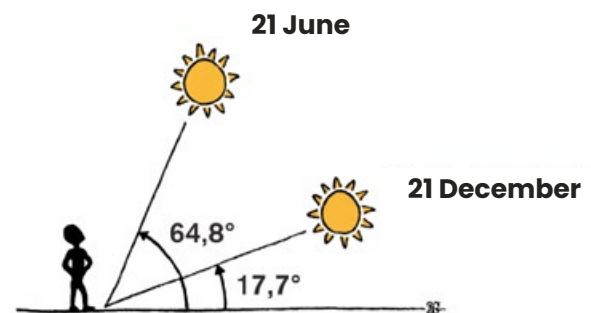
The first examines the **number of hours of direct sunlight received in public spaces**, particularly in winter. In colder climates, sunlight transforms outdoor areas. It raises surface temperatures slightly, improves perceived comfort, and often has a psychological effect that goes beyond physics. In northern regions especially, even a brief moment of winter sun can change how a space feels.

The second method evaluates whether each apartment or house receives at **least one hour of direct sunlight on the shortest day of the year**. This approach is straightforward and robust, offering a clear benchmark for residential quality. Its limitation is structural: north-facing façades inevitably score zero, regardless of broader spatial qualities.

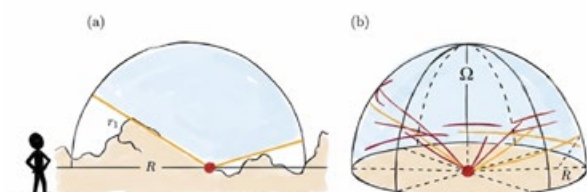
The third metric is the Sky View Factor. Expressed as a percentage, it measures **how much of the visible sky is accessible from a given point**, typically through a window. It complements the direct sunlight criterion. Even in the absence of direct solar exposure, access to a wide portion of the sky allows for higher levels of diffuse daylight. Light, after all, is not only direct sun. It is also the brightness of the open sky.



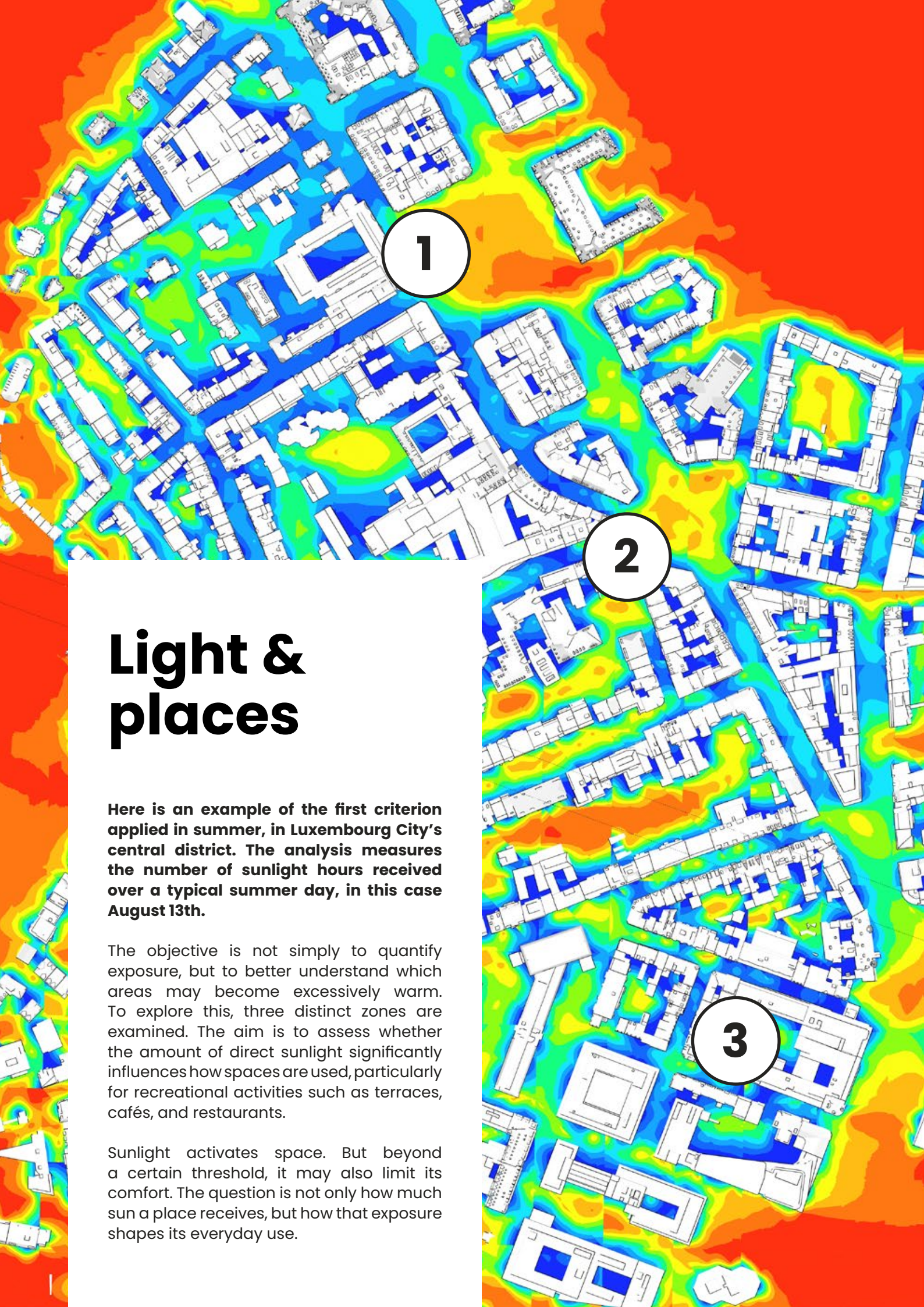
Light in public space in winter



Light on 21 December



Sky view factor



Light & places

Here is an example of the first criterion applied in summer, in Luxembourg City's central district. The analysis measures the number of sunlight hours received over a typical summer day, in this case August 13th.

The objective is not simply to quantify exposure, but to better understand which areas may become excessively warm. To explore this, three distinct zones are examined. The aim is to assess whether the amount of direct sunlight significantly influences how spaces are used, particularly for recreational activities such as terraces, cafés, and restaurants.

Sunlight activates space. But beyond a certain threshold, it may also limit its comfort. The question is not only how much sun a place receives, but how that exposure shapes its everyday use.

What do we observe across the three zones?
Two open squares receive a relatively high level of sunlight throughout the day, while a narrower street remains comparatively shaded, even in summer.



2

Place de Paris

Place de Paris is equally sunlit in summer, yet far more active. Bars and restaurants animate its edges, and terraces extend into the square, softened by parasols.

Although the space offers little natural shade and may feel warm, it remains a gathering place. Exposure alone does not define use. Activity transforms it.



Ultimately, activity placement is driven less by comfort and more by historical or economic inertia; because people naturally adapt to their surroundings, planning must focus on either

1

Place des martyrs

Place des Martyrs in Luxembourg is largely exposed to the sun. Yet despite this generous light, little activity seems to take place there.

The square functions partly as a park, but with limited shade. In full summer sun, the space may feel exposed and less inviting, even if it remains visually pleasant. It is an example of a simple paradox: light alone does not guarantee vitality. A space can be bright and still remain quiet.



3

Rue Joseph Junck

Rue Joseph Junck receives comparatively little sunlight, yet its terraces remain dense and active, even with additional parasols.

In the end, this suggests that direct sun exposure may not be the dominant factor in terrace activity here. Urban intensity, location, and social dynamics appear to matter just as much.

placing functions where the environment is already favourable or proactively adapting the built environment to sustain them.

Trees & greenery

Green spaces rarely attract the same attention as buildings, yet they shape the climate of a city just as profoundly. Trees, permeable soils, parks, and open plains work together as a living system. Vegetation cools the air through shade and evapotranspiration, softens the wind, and adjusts seasonally by allowing winter light to pass through bare branches.

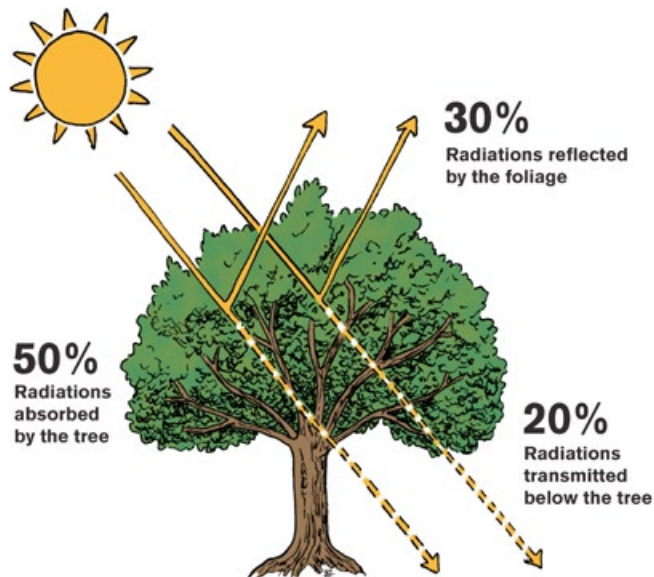
Beneath it, permeable ground absorbs rainwater, supports root systems, and prevents the overheating typical of sealed surfaces. At a larger scale, parks function as urban lungs, improving air quality and sustaining biodiversity in otherwise mineral environments. Open green plains can even contribute to nighttime cooling, releasing stored heat more gently and allowing fresher air to settle.

These landscapes are not decorative additions. They are climate regulators, quietly structuring comfort across seasons.

And beyond these measurable effects, green spaces matter in a quieter way. For many people, they are places of relief, routine, and belonging. Not only climate regulators, they are shared environments that support both physical comfort and everyday well-being.



**The best
architecture
learns from trees:
filter the light,
soften the wind,
create comfort.**

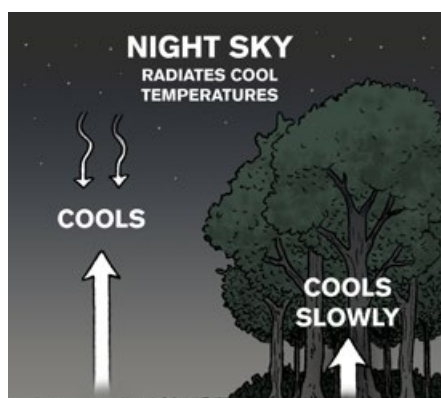


IN SUMMER, TREES OPERATE AS LIVING INFRASTRUCTURE, PROVIDING SHADE, REFLECTING LIGHT SKYWARD, AND COOLING THE AIR THROUGH EVAPOTRANSPIRATION ALL AT ONCE.

A significant share of the solar energy responsible for urban overheating can be moderated by trees, with up to 80% either reflected back towards the sky or absorbed within the canopy before it reaches the ground. This interception reduces surface temperatures and limits the amount of heat stored in pavements and façades. Even in the shade, brightness remains. Light becomes filtered and diffuse, softer on the eye, subtly coloured by foliage. It is difficult to express in numbers, yet its quality is immediately perceptible, particularly in autumn when tones shift and spaces take on a warmer character.

Still, trees are only part of the balance. While they are crucial during the day, cities also benefit from open grounds and clearings.

At night, these exposed surfaces can radiate accumulated heat towards the cooler sky, supporting the formation of fresher air near the ground. The interplay between shaded areas and open terrain allows urban environments to regulate both daytime comfort and nocturnal cooling.



Key takeaway



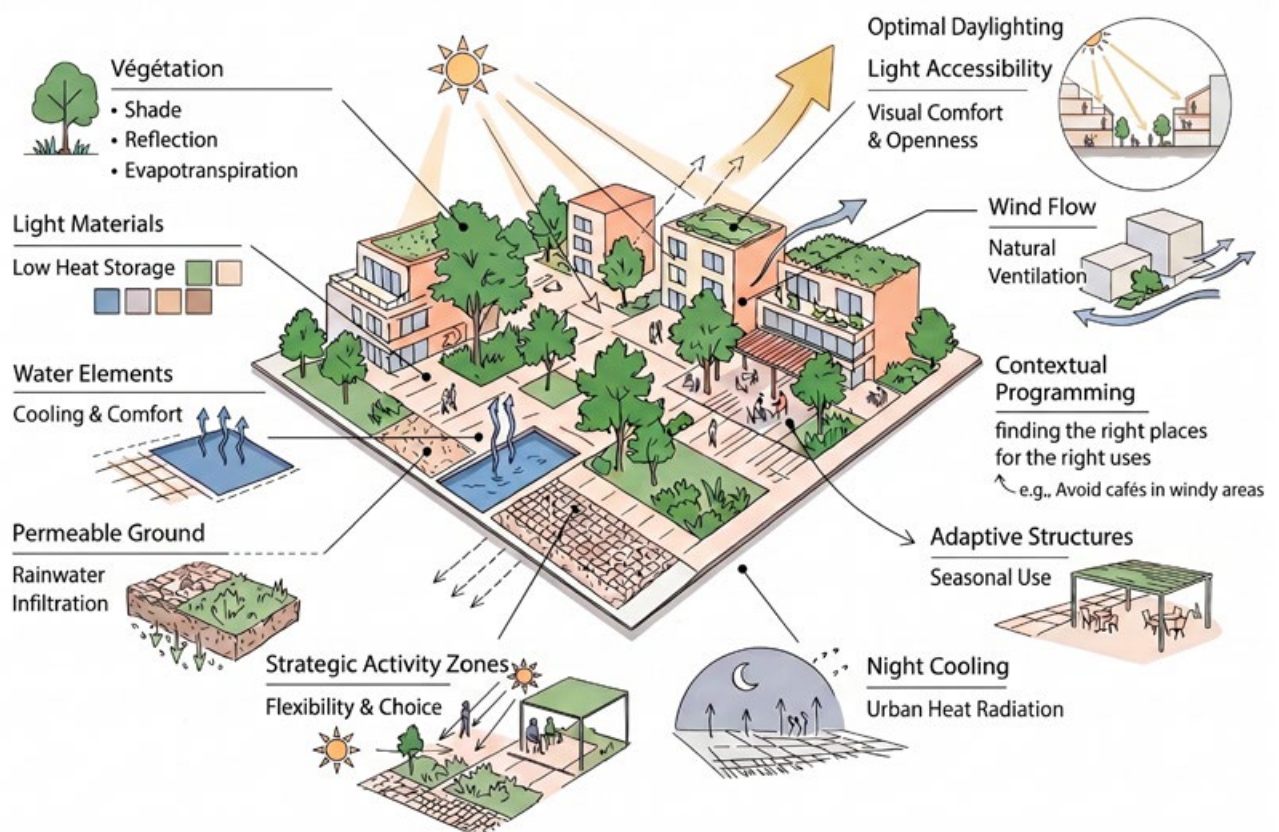
Designing a district does not necessarily begin with complex equations. It begins with a handful of deliberate choices that shape comfort, resilience, and everyday livability.

Reintroducing vegetation is one of them. Trees, planted areas, and permeable soils restore natural regulation, while varied ground materials prevent the continuous heat storage typical of concrete and asphalt. Lighter colours, porous surfaces, and integrated water elements reduce thermal accumulation and offer moments of freshness. Limiting unnecessary heat sources, especially dark, massive, sealed surfaces, is often as effective as adding new systems.

Comfort also depends on diversity. Cities should provide sun for those who seek light and shade for those who need protection. Shade can come from trees, light canopies, pergolas, or adaptable devices that evolve with the seasons. Plazas, terraces, and streets should be oriented to daylight, extending their usability across

the year. Flexible elements such as awnings, screens, and movable structures allow spaces to respond to changing climates and patterns of use. Building height and density must be carefully managed to preserve a sufficient sky view factor, enabling heat to dissipate at night while maintaining openings that invite breezes without creating wind tunnels.

Equally important is social reality. A district succeeds only if people choose to inhabit it. Climate strategies cannot be separated from cultural expectations and daily practices. These principles are articulated with Luxembourg in mind, where a temperate climate balances summer heat and winter cold, and where the scale of districts shapes specific priorities. Other contexts will require adaptation. Yet the underlying idea remains constant: climate, comfort, and social life must be designed as one coherent system.



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25	Energie et Environnement S.A. Study	Temperature simulation

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Urban Lines – July 2026

Thomas LÖFFLER – Julien L'HOEST – Baptiste GUELORGET



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Comfort is not a fixed condition. It is a dialogue with the seasons.