

SUSTAINABLE SKIES

AND SAFE URBAN SPACES IN CHILE

AUTHORS

Dr. Daniela González Espinoza
Dr. Macarena Rau Vargas



CORPORACIÓN CPTED REGIÓN
ICA CHAPTER

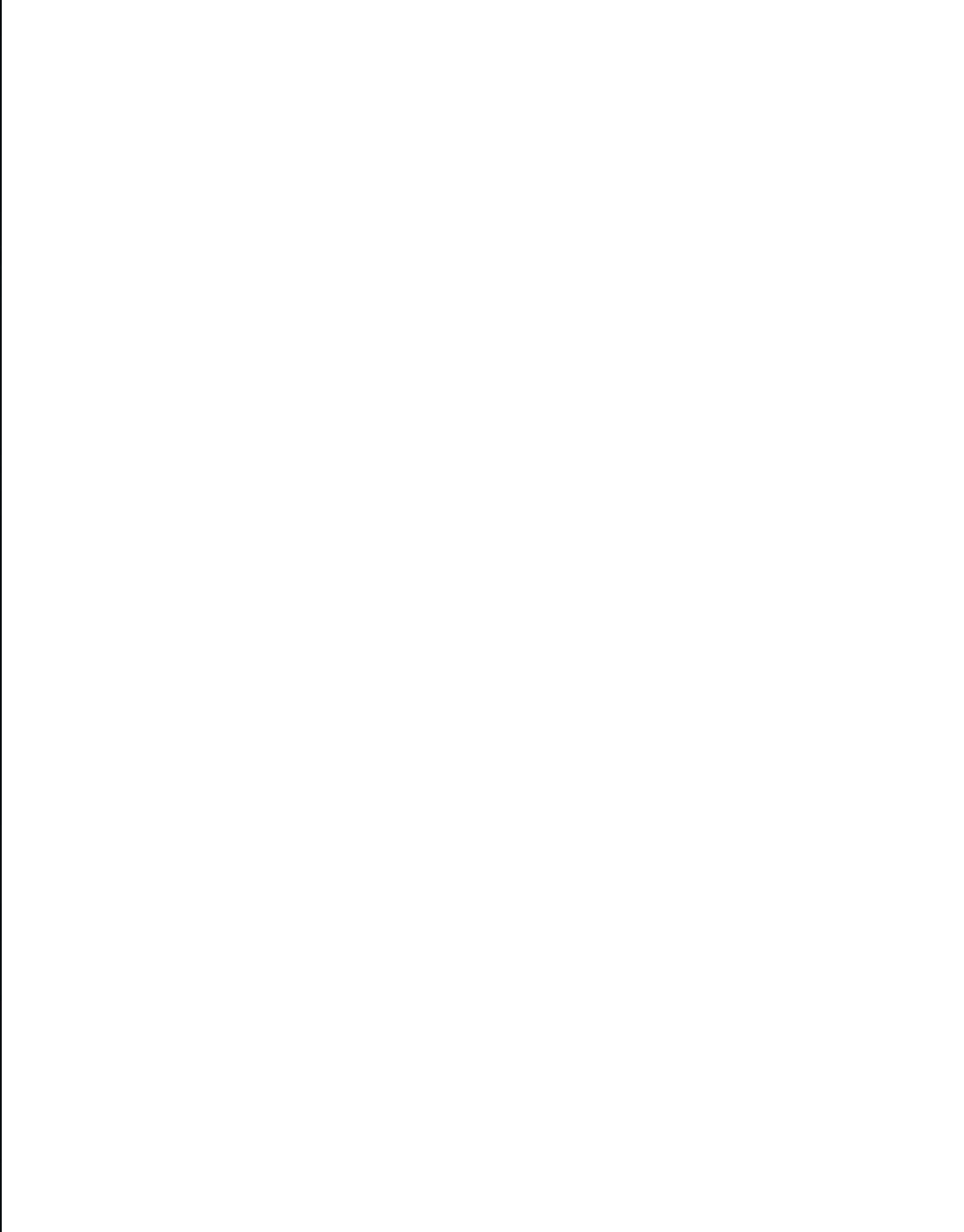


TABLE OF CONTENTS

Foreword by Dr. Macarena Rau, ICA President

p. 6

Foreword by Dr. Daniela González, Executive Director of Fundación Cielos de Chile

p. 7

Glossary

p. 8

1

Executive Summary

p. 12

2

The CPTED Methodology

p. 14

2.1

Evolution of the CPTED methodology: first, second, and third generation

p. 16

2.2

Lighting from a CPTED perspective

p. 17

3

Light Pollution

p. 18

3.1

The state of light pollution

p. 20

3.2

Lighting regulation in Chile

p. 21

4

Natural surveillance: “Seeing and being seen” without glare

p. 22

5

Natural access control: nighttime legibility and “unambiguous” routes

p. 28

6

Territorial reinforcement + activity support: sense of place and legitimate use without “overlighting”

p. 32

7

Maintenance and management: socio-environmentally co-designed CPTED sustainability

p. 36

8

Implementation in Chile: specifications, procurement, and verification

p. 40

Conclusions

p. 44



FOREWORD BY ICA PRESIDENT

Dr. Macarena Rau

Urban Safety is becoming increasingly urgent in cities across Chile and the world. Amid this environmental urgency, the CPTED methodology represents a major contribution. International evidence increasingly shows that Urban Safety is aligning with a safe and sustainable environment. In that sense, what matters is not only reducing crime indicators and the perception of fear in cities across Chile and Spanish-speaking America, but also protecting clean skies free of light pollution.

The alliance of joint actions in this regard between the CPTED Region_ICA Chapter Corporation and Fundación Cielos de Chile is essential not only to raise awareness among other professionals involved in urban and environmental affairs, but also to generate joint evidence of interventions that can be regarded as good practices in both areas.

This booklet seeks to contribute to this effort by combining the latest generation of CPTED with the full body of content developed by Fundación Cielos de Chile.



FOREWORD BY EXECUTIVE DIRECTOR OF FUNDACIÓN CIELOS DE CHILE

Dr. Daniela González

Night is also part of the city. It is not merely the time that follows the day, but an environmental, social, and cultural dimension that shapes the way we inhabit our territory, find our bearings within it, and share common spaces. At Fundación Cielos de Chile, we have long argued that protecting natural darkness is not an isolated aspiration or an interest limited to astronomy. It is a task connected to people's health, to biodiversity, to the quality of the nighttime landscape and, also, to the way we design more livable cities.

This booklet stems precisely from that conviction. Its value lies in building a bridge between two areas that have too often been considered separately: urban safety and the protection of the nighttime environment. Linking this work to the CPTED methodology makes it possible to show that there is no contradiction between these two objectives. On the contrary, well-designed lighting can contribute to natural surveillance, to the legibility of space, and to the legitimate use of places, without deteriorating the night sky or producing unnecessary impacts on the environment.

Chile's new lighting regulation calls for progress in that direction with greater technical rigor, but also with a more integrated perspective. It is no longer just about lighting, but about deciding why, how, when, and with what effects a space is lit. We hope this publication contributes to strengthening that discussion and to promoting design, management, and implementation decisions that help build urban spaces that are safer, more conscious, and more environmentally responsible.

GLOSSARY

Blue light component

Spectral fraction of artificial light that the regulation restricts due to its greater atmospheric dispersion and its effects on health and biodiversity.

Certification

Technical verification of luminaires and projectors in accordance with the procedures and protocols required by current regulations.

Citizen participation in safety

Active community involvement in the diagnosis, design, execution, and upkeep of local safety strategies.

Citizen safety

Conditions that protect people’s lives, property, and coexistence against criminal, social, or environmental threats.

Correlated Color Temperature (CCT)

Measure describing the chromatic appearance of the light emitted by a source.

CPTED (Crime Prevention Through Environmental Design)

A crime prevention methodology based on environmental design, aimed at reducing risk and the perception of insecurity through the configuration of space.

Crime of opportunity

A criminal act that occurs when a motivated offender, a vulnerable setting, and an attractive victim or target coincide.

Glare

Visual effect produced by a poorly controlled light source that reduces comfort, visual adaptation, and observation capacity.

Light pollution

Alteration of the nighttime environment caused by excessive, poorly directed, or unnecessary artificial light, affecting the night sky, human health, biodiversity, and the habitability of space.

Light trespass

Unwanted entry of artificial light into homes or areas that do not require lighting.

Local public management of citizen safety

Coordinated action by local governments and technical teams to diagnose, design, and implement crime prevention and fear-reduction strategies.

Maintenance

Set of management, cleaning, gardening, and conservation actions that keep a space legible, cared for, and appropriate.

GLOSSARY

Natural access control

Design strategy that organizes access points, routes, and thresholds to make a space more legible and reduce opportunities for improper use.

Natural surveillance

The capacity of a space to facilitate spontaneous observation among users through visibility, lighting, landscape design, and appropriate indoor-outdoor relationships.

Outdoor lighting

Set of light sources installed in outdoor spaces and regulated by Chilean law, including pedestrian, vehicular, industrial, sports, recreational, and advertising lighting.

Perception of insecurity

Subjective feeling of fear or vulnerability toward crime, which does not always match the actual occurrence of criminal events.

Reflected emission

Light reflected off pavements, facades, or other surfaces, which can also contribute to light pollution.

Situational prevention

Approach that seeks to reduce criminal opportunities through the design, management, and transformation of the immediate environment.

Social prevention

Non-penal strategies aimed at reducing the social factors that favor crime.

Special Protection Areas (SPA)

Zones where the lighting regulation sets stricter requirements to safeguard astronomical areas and biodiversity-sensitive sectors.

Territorial reinforcement

Condition whereby a space expresses a sense of belonging, use, and care, favoring appropriation and a sense of place.

Time-based control

Regulatory requirement that mandates, depending on the type of lighting, the shutdown or reduction of emissions during specific hours.

Upward light emission

Light emitted above the horizontal plane of the luminaire, the control of which seeks to prevent sky glow.

1

EXECUTIVE
SUMMARY

This publication proposes an integrated reading of the CPTED methodology and light pollution prevention, with the aim of providing criteria for the design, management, and implementation of safer and more environmentally responsible nighttime urban spaces.



Its starting point is that urban safety

does not depend on indiscriminately increasing lighting levels, but on improving the quality of the built environment, the legibility of space, and the appropriate use of artificial light.

Along these lines, the document links classic CPTED principles —natural surveillance, natural access control, territorial reinforcement, and maintenance— with the requirements of Supreme Decree No. 1/2022 of the Ministry of the Environment, which regulates outdoor lighting in Chile in order to protect the astronomical quality of the night sky, human health, and biodiversity.

Building on this, the document develops an approach that understands the night as a critical dimension of urban design. It examines the current state of light pollution in Chile, the new regulatory framework and its implications for territorial planning, and then explores in depth the application of CPTED principles at night, highlighting that

lighting should promote useful visibility, orientation, recognition of access points, legitimate use of space, and visual comfort, while avoiding glare, light trespass, unnecessary emission, and overlighting. The document concludes that the convergence between urban safety and the protection of the nighttime environment is not only possible but necessary, and that its proper implementation requires better criteria for design, procurement, maintenance, verification, and technical training in both the public and private sectors.



2

THE CPTED METHODOLOGY

2.1 Evolution of the CPTED methodology: first, second, and third generation

The CPTED methodology can be understood as a living approach, one that has evolved as the ways of inhabiting, using, and managing cities have changed.

First generation

In its first generation, CPTED focused mainly on the physical design of the environment as a tool for reducing criminal opportunities. During this stage, principles such as natural surveillance, natural access control, maintenance, and territorial reinforcement were consolidated. The focus was on how spatial configuration could discourage criminal behavior and increase the perception of control over a place.

Second generation

Later, the second generation broadened this approach, recognizing that physical design alone is not enough without a community capable of appropriating, using, and sustaining a space over time. During this stage, community participation, social cohesion, and neighborhood livability took center stage. Safety was then no longer understood solely as a result of physical design, but also came to be linked to the quality of social relationships, trust, and the community’s capacity for organization.

Third generation

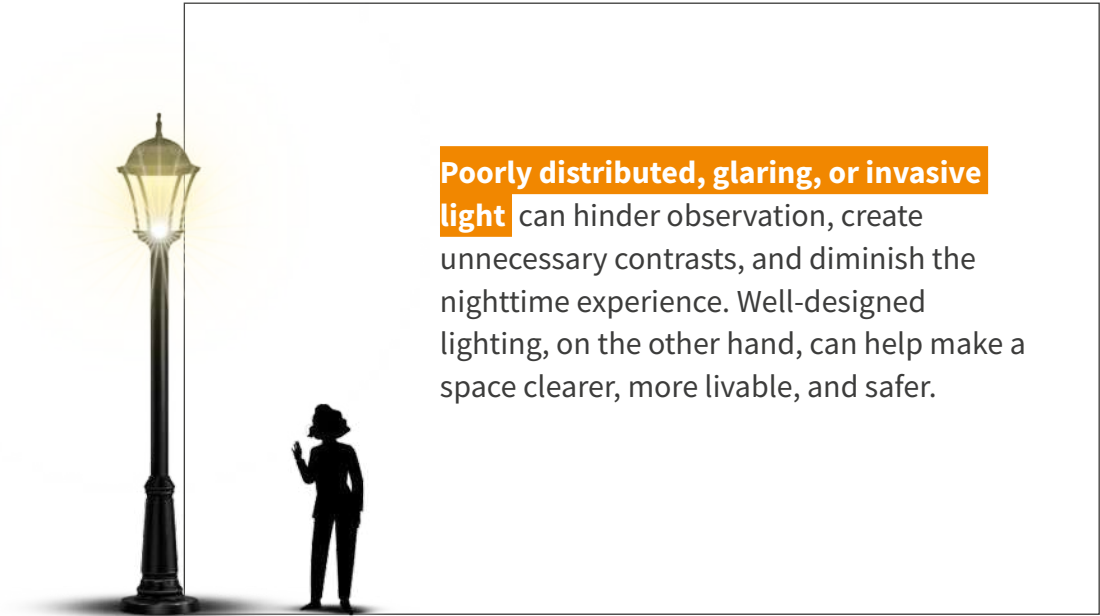
The third generation of CPTED deepens this evolution, explicitly incorporating sustainability as part of the urban safety challenge. From this perspective, a safe space is not only one that reduces criminal opportunities, but also one that promotes well-being, health, and environmental balance. In this way, the methodology adopts a broader view of human security, bringing together social, health, economic, and environmental dimensions. This development is especially relevant to the current context, in which the quality of nighttime urban space cannot be separated from issues such as light pollution, livability, and environmental protection.

2.2 Lighting from a CPTED perspective

From a CPTED perspective, lighting does not prevent crime on its own, but it can make an important contribution by helping people better understand a space, recognize routes, identify other users, and reduce their perception of insecurity. Lighting provides visual information and, in that sense, supports decisions about how a space is

used, moved through, and occupied. Its value lies in fostering natural surveillance, orientation, and the legibility of space, rather than acting as an autonomous control mechanism.

For this reason, the quality of lighting is more important than its mere intensity.



This point is fundamental in CPTED, because urban safety is built not only through crime reduction, but also through reducing the perception of fear and improving the quality of life of those who use the city on a daily basis.

A silhouette of a person's head and shoulders is shown in profile, looking towards the left. The background is dark with numerous out-of-focus city lights in warm orange, yellow, and cool blue tones, creating a bokeh effect. An orange square with the number 3 is positioned above the title text.

3

LIGHT POLLUTION

3.1 The state of light pollution

Light pollution has become one of the most significant emerging environmental problems for the management of nighttime territories.

In Chile, its importance is especially critical because it converges on four strategic dimensions:



Safety and Livability of Urban Spaces



Biodiversity protection



Human health



Protection of Dark Skies for Astronomical Observation

This is not simply a matter of “having a lot of light,” but of lighting poorly: with excessive intensity, upward emission, glare, light trespass onto homes and ecosystems, and a high presence of blue light, which disperses more easily in the atmosphere and amplifies night sky brightness. The result is a night that is artificially altered, less comfortable, and more environmentally fragile.

In Chile’s case, this phenomenon takes on a particular severity due to the coexistence of large urban centers, industrial expansion, road infrastructure, mining activity, and the presence of some of the world’s most important astronomical sites.

Light pollution should therefore not be understood as a sector-specific issue limited to astronomy, but as a matter of territorial planning and nighttime environmental quality. From a CPTED perspective, this is especially relevant: a safer city is not one that simply adds more light, but one that lights with purpose, control, uniformity, and appropriateness of use. Lighting that dazzles, creates extreme contrasts, or spills into areas not intended for nighttime use can undermine natural surveillance rather than strengthen it. The contemporary challenge, then, is to reconcile urban safety and visual performance with criteria of sustainability, public health, and night sky protection.

3.2 Lighting regulation in Chile

Chile has a robust regulatory framework to address this problem. Its cornerstone is Supreme Decree No. 1/2022 of the Ministry of the Environment, in force since October 19, 2024, which replaces the previous regulation and explicitly broadens its protection objectives.

Key Milestones

2024

It no longer protects only the astronomical quality of the night sky, but also human health and biodiversity.

This regulation covers outdoor lighting sources, including pedestrian, vehicular, industrial, sports, and recreational lighting, as well as advertising lighting, and sets requirements for light direction, emission levels, and spectral restrictions, with particular attention to the blue light component.

The new regulation also introduces a differentiated territorial criterion through Special Protection Areas. These notably include astronomical areas declared by the Ministry of Science and areas linked to biodiversity that is sensitive to artificial light. In these territories, compliance deadlines are more demanding and spectral restrictions are stricter. For new sources in astronomical areas, compliance has been required since October 19, 2024.

2026

For new sources in the rest of the national territory, from October 19, 2026.

For existing sources, compliance is triggered upon replacement and, in certain municipalities near astronomical sites, there is a final deadline of October 19, 2029. The implementation of this regulation has been reinforced by four technical protocols issued during 2024, which govern the analysis, measurement, certification, and regularization of existing sources. Consequently, Chilean regulation now provides a concrete basis for guiding procurement processes, urban projects, and design decisions compatible with a third-generation CPTED approach: safer, healthier, and environmentally responsible.

The background of the slide is a dark, low-key photograph of two people walking on a paved surface at night. Their figures are mostly in silhouette, with some highlights on their clothing and the ground. The scene is dimly lit, creating a moody atmosphere.

4

NATURAL SURVEILLANCE:
“SEEING AND
BEING SEEN”
WITHOUT GLARE

Natural surveillance is one of the fundamental principles of the CPTED methodology and refers to a space’s ability to facilitate spontaneous observation among those who inhabit, move through, or use it. Its purpose is not to establish a logic of permanent control, but to create environmental conditions that make it possible to recognize what is happening in the surroundings, distinguish access points, read pathways, identify

movement, and anticipate risk situations. At night, this principle takes on particular importance, since the amount of available visual information decreases and the quality of a space depends to a greater extent on how light is organized. In this context, natural surveillance cannot be reduced to the mere presence of luminaires, much less to an indiscriminate increase in intensity.



In Chile, this discussion must be understood in light of D.S. No. 1/2022 of the Ministry of the Environment, which regulates outdoor lighting emissions with the aim of preventing light pollution and protecting the astronomical quality of the night sky, human health, and biodiversity. This regulation introduces a criterion that is particularly relevant to the CPTED perspective: not all light contributes equally to safety or to the habitability of a space. Technically poor lighting can produce glare, generate excessive contrasts, spill into areas that do not require lighting, or project beyond the surface where it is actually needed. Consequently, the issue is not only how much to light, but how to do so and with what degree of control.

From a technical standpoint, one of the most important aspects for natural surveillance is the direction of light. Chilean regulation requires that, for pedestrian, vehicular, and industrial lighting, **emission above the horizontal plane be strictly controlled, setting luminous intensity limits at 90°** and prohibiting emission beyond that angle. This requirement, which may at first appear purely environmental, has a direct impact on the visual quality of nighttime space. A poorly oriented luminaire not only increases light pollution; it can also dazzle users, reduce their visual adaptation

capacity, and hinder the reciprocal observation that CPTED seeks to strengthen. **Natural surveillance therefore requires that light remain on the surface it is meant to serve, that it accompany routes, and that it allow relevant elements of the environment to be clearly distinguished, without exposing observers to an aggressive light source.**

In practice, this means that choosing the right luminaire does not solve the problem on its own. Mounting height, tilt, shielding, and the relationship between the equipment’s photometric distribution and the space where it is installed all matter as well. A pedestrian access point, a sidewalk, a crossing, a bike lane, or a parking area each require different configurations, because natural surveillance depends on how effectively a place can be read. If lighting concentrates excessive intensity at a single point while leaving residual dark zones in between, the visual result can be poorer than a lower-power but better-distributed solution. Likewise, if a user perceives the light source before the space itself, the intervention loses effectiveness from the standpoint of natural observation.

The regulation also introduces another highly important aspect: **the control of reflected emission. For pedestrian and vehicular lighting, maintained average luminance and illuminance levels must not exceed the maximum values set by sector-specific regulations.** This point is particularly relevant for CPTED, as it requires distinguishing between sufficient and excessive lighting. In many urban projects, safety has been mistakenly associated with oversized amounts of light, without considering that excess light can cause visual fatigue, loss of useful contrast, and a more confusing reading of space. Natural surveillance does not improve when everything is excessively lit, but when the environment can be understood clearly, continuously, and without abrupt adaptation efforts.

Another element highlighted by D.S. No. 1/2022 is the spectral composition of light. The regulation restricts emission in the blue range both across the national territory in general and, with stricter requirements, within Special Protection Areas. This provision responds to environmental and health criteria, but also has implications for nighttime design. It requires that a light source be considered not only in terms of power or energy efficiency, but also in terms of its actual behavior in space and the quality of the light it delivers. In this sense, natural surveillance must be compatible with outdoor

lighting that allows for recognition and orientation without unnecessarily resorting to spectra with high atmospheric dispersion or a greater impact on the environment. The regulation thus shifts the focus from a purely technological performance logic to one of environmental and spatial performance.

These requirements become even clearer in specific uses. For ornamental and decorative lighting, the regulation limits color temperature, sets a zero-flux requirement toward the upper hemisphere, and establishes time-of-use restrictions. For sports and recreational lighting, it controls intensity at 90°, prohibits emission beyond that angle, regulates color temperature according to the type of venue, and requires a nighttime shutdown schedule. For illuminated signs and billboards, it sets luminance limits, requires avoiding orientation toward dwellings, and likewise establishes a nighttime shutdown requirement. From a CPTED perspective, these provisions are relevant because they establish hierarchies within the nighttime landscape. Functional light intended for routes, access points, and areas of permanence should not compete with an illuminated facade, an oversized sports venue, or a dominant advertising element. Natural surveillance requires that the primary visual information in a space be the one that guides its use, not one that distracts from or overloads the field of vision.

For this reason, “seeing and being seen” does not mean exposing the entire space to the maximum possible intensity, but rather creating conditions of reasonable, continuous, and controlled visibility. A good lighting project, within the framework of CPTED and Chile’s lighting regulation, is one that distinguishes between circulation, permanence, and edge areas; that places light where it serves a precise function; that controls both direct and reflected emission; that avoids glare and light trespass; and that maintains a coherent relationship between safety, livability, and environmental protection. From this perspective, natural surveillance is not an automatic effect of technology, but the result of a design decision.

Ultimately, Chilean regulation reinforces an idea that CPTED has put forward since its origins: the quality of the nighttime environment does not depend on more light, but on better light. Outdoor lighting should make it possible to recognize a space, guide movement, distinguish other users, and facilitate the legitimate use of a place, without turning the night into a uniform, glaring, or aggressive surface.

Properly understood, natural surveillance is precisely that: an environmental condition in which visibility contributes to safety and livability without diminishing the visual experience or the balance of the surrounding environment.

5

NATURAL ACCESS CONTROL: NIGHTTIME LEGIBILITY AND “UNAMBIGUOUS” ROUTES

Natural access control is one of the foundational principles of the CPTED methodology and aims to reduce criminal opportunity through the design of space. Its purpose is not to turn the city into a series of barriers or to artificially harden the environment, but to organize it so that access points, routes, thresholds, and entry or exit points are clear to legitimate users and less favorable to improper use. In its most classic formulation, this principle involves connecting direct access points to observable areas, avoiding the placement of entrances in unseen areas, naturally guiding people, and providing a limited, legible number of access routes. In other words, it is about making it evident where one enters, circulates, and exits, so that the space is not left open to ambiguous interpretation.

At night, this principle takes on a particularly sensitive dimension, since the loss of visual information makes it harder to interpret edges, recognize transitions, and distinguish between a proper access point and a residual passage. For this reason, from a CPTED perspective, natural access control depends largely on the nighttime legibility of a space. A legible place is one whose organization can be understood without excessive effort: it clearly shows its main routes, differentiates public from restricted access points, anticipates changes in direction, and prevents users from being exposed to disorientation, entrapment, or uncertainty. When this condition fails, informal routes, unsafe shortcuts, ambiguous crossings, and unintended gathering areas begin to appear. The problem,

therefore, is not only one of circulation, but also of perception and use.

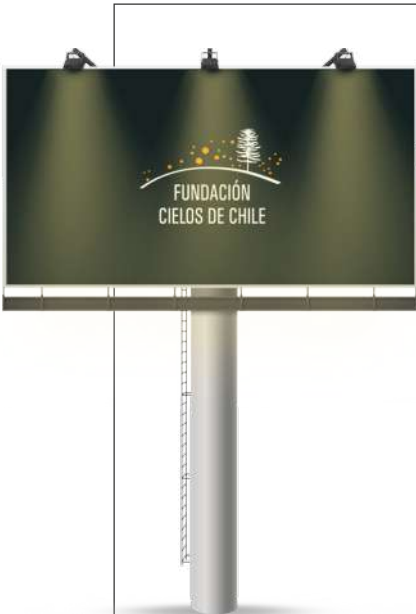
Lighting plays a decisive role here, though not in the sense of visually “opening up” the entire space with the greatest possible power. **As with natural surveillance, the challenge is to light with hierarchy.** A main entrance, a pedestrian crossing, a threshold between public and semi-public space, an exit route, or a connection to transit all require clear, continuous visual cues. However, this clarity is not achieved by flooding every surface with light, but by properly distinguishing what is important from what is secondary. An unambiguous route is not the brightest one, but the most understandable one. Lighting should therefore help read the route, not compete with it.

At this point, D.S. No. 1/2022 of the Ministry of the Environment provides a particularly useful framework for thinking about natural access control in Chile, requiring a move away from generic solutions toward more precise design.

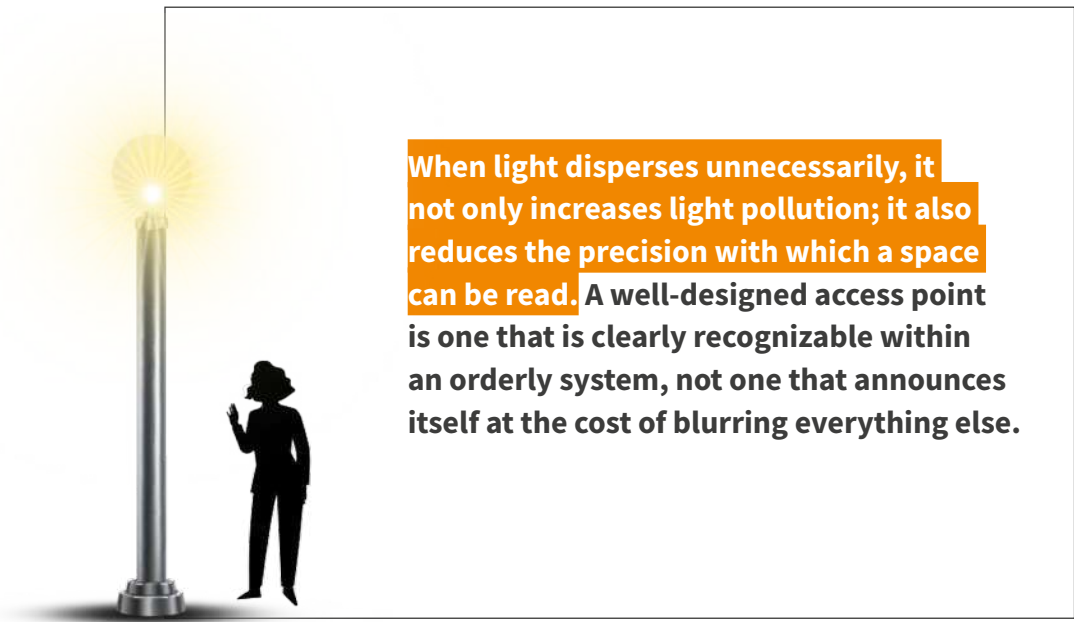
A pedestrian route, a vehicular access point, the edge of a facility, or a transition space do not require the same light distribution, nor the same relationship between mounting height, orientation, and photometry. When this specificity is lacking, the result tends to be a visually flat environment, where it is difficult to identify spatial priorities.

From a technical standpoint, natural access control first requires distinguishing between primary and secondary routes. The former should concentrate visual continuity, orientation, and destination recognition; the latter can support the system but should not compete with it. This involves working with a coherent sequence of light points, avoiding gaps between sections, abrupt contrasts, or glare that disrupts legibility. It also requires that an access point be visible before it is reached, not only once the user is right in front of it. **In design terms, this means paying attention to the relationship between viewing distance, luminaire height, uniformity, and the control of visual obstructions. An access point hidden behind poorly placed vegetation, misplaced furniture, or abrupt changes in elevation remains problematic even if the luminaire technically meets its specifications.**

This principle is also related to the correct reading of thresholds. **Since its earliest formulations, CPTED has stressed the importance of a space naturally signaling when one is entering a different area.** This transition can be built through pavement, vegetation, changes in width, furniture, permeable enclosures, textures, or lighting. At night, light can reinforce this condition if it accompanies the passage from a public street to a controlled access point, from a circulation zone to an area of permanence, or from an open space to a semi-private one. But if lighting is homogeneous and undifferentiated, the threshold disappears, and with it, a significant part of territorial control. For this reason, nighttime legibility is not just about “seeing the way,” but also about understanding the nature of the place being entered.



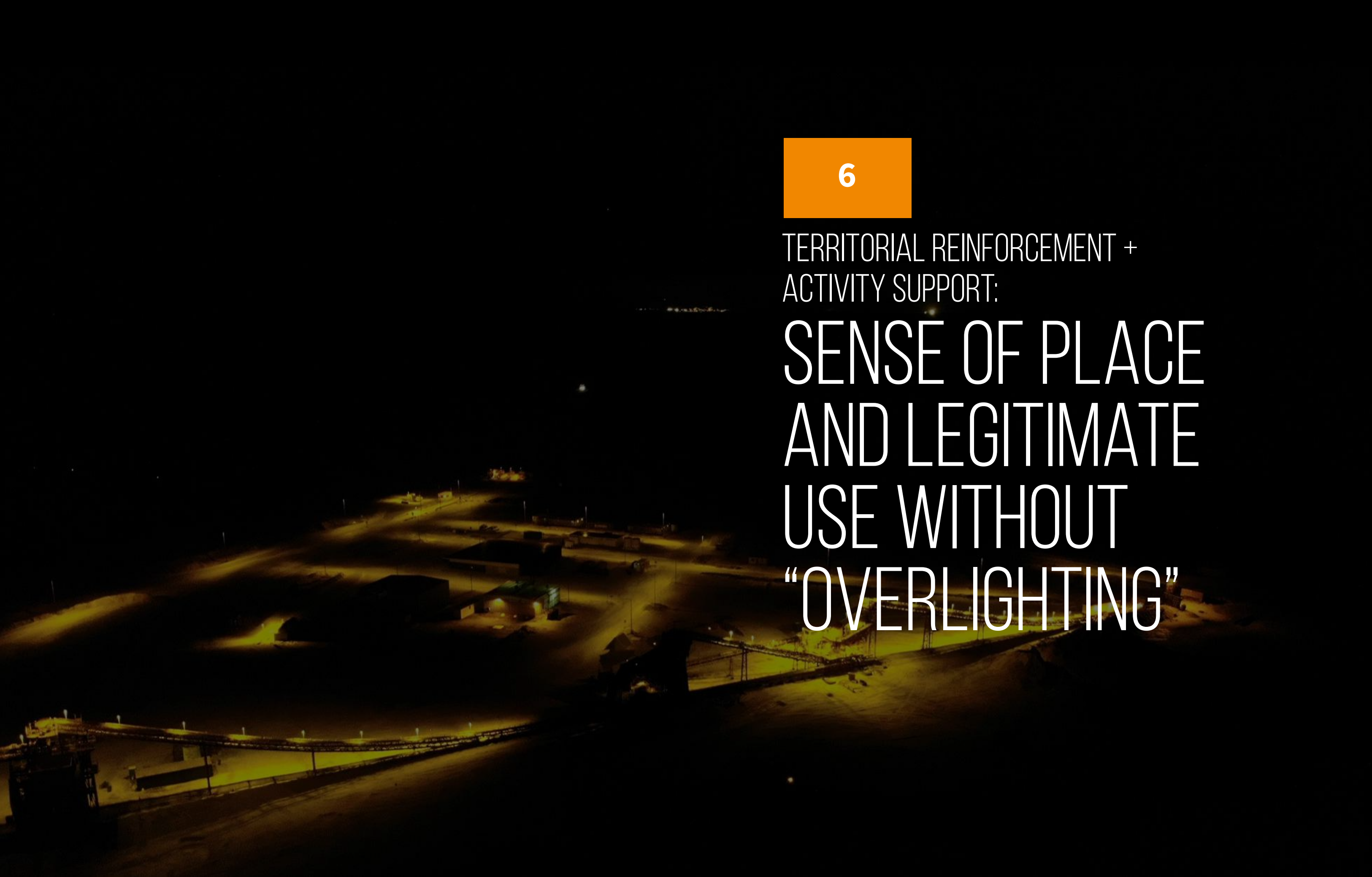
Chile’s lighting regulation also reinforces a criterion that is particularly relevant here: light should not spill onto surfaces that are not part of a project’s primary function. In terms of access control, this means that lighting should be concentrated on entrances, exits, changes in direction, connections, and relevant edges, without spilling into homes, patios, or other areas that do not require functional lighting.



When light disperses unnecessarily, it not only increases light pollution; it also reduces the precision with which a space can be read. A well-designed access point is one that is clearly recognizable within an orderly system, not one that announces itself at the cost of blurring everything else.

Along the same lines, time-of-use restrictions for certain decorative, sports, or advertising lighting are a reminder that not all light contributes to orientation. **For a route to be unambiguous, the primary visual information must come from the functional lighting of the route itself, not from secondary elements that capture attention or distort the spatial hierarchy.** An access point that competes with an illuminated facade, a dominant sign, or a source of lateral glare loses clarity. Natural access control therefore requires a kind of visual economy: showing what is necessary, reinforcing what is important, and removing what is superfluous.

Ultimately, **natural access control, read from the perspective of nighttime space, consists of building understandable routes, clear transitions, and observable entrances, so that legitimate users can find their way easily and improper use finds fewer opportunities.** Lighting makes a decisive contribution to this goal when it organizes the route, accompanies thresholds, and reinforces the structure of a place without overlighting it. This is where the deepest connection between CPTED and Chile’s lighting regulation lies: both require understanding that safety does not come from excess, but from clarity. An unambiguous route is not the most intense one, but the one that is best read.

An aerial night photograph of an industrial facility, possibly a refinery or chemical plant. The scene is illuminated by a warm, yellow light, likely from the facility's own lighting. The image shows various structures, including buildings, storage tanks, and a network of pipes or walkways. The lighting creates a strong contrast between the brightly lit areas and the surrounding darkness, highlighting the layout of the site. The overall atmosphere is industrial and somewhat somber due to the night setting.

6

TERRITORIAL REINFORCEMENT +
ACTIVITY SUPPORT:

SENSE OF PLACE
AND LEGITIMATE
USE WITHOUT
“OVERLIGHTING”

Territorial reinforcement, within the CPTED methodology, relates to a space’s ability to clearly express that it belongs to someone, and that it is used, cared for, and recognized by its regular users. This is not simply a matter of physical delimitation, but of the construction of meaning. A space with a legible identity, understandable edges, clear signs of use, and activities that are compatible over time tends to foster everyday appropriation and reduce the ambiguity that often facilitates deterioration, disorientation, or improper use. When this principle is linked to activity support, the idea becomes even more concrete: design must help ensure that a place has a legitimate, recognizable, and lasting use, without depending on an overload of infrastructure or, even less, an overload of lighting.

At night, this principle takes on additional complexity. The identity of a place is no longer built only through pavement, vegetation, furniture, or facades, but also through the way light organizes the perception of space. Lighting can reinforce thresholds, routes, areas of permanence, and active edges, but it can also blur them if it is distributed without hierarchy or if it turns the entire environment into a homogeneous, excessively bright surface.

From this perspective, territorial reinforcement should not translate into an undifferentiated increase in light levels. In a plaza, a median strip, a pedestrian access point, a community perimeter, or a neighborhood facility courtyard, what matters is not that the entire surface receive the same intensity, but that users can easily recognize where to circulate, where to remain, where a semi-private area begins, and where the common-use space ends. Lighting fulfills its role well when it supports this structure and makes it legible —not when it erases it. Technically, this involves working with photometric distribution suited to the use, mounting heights compatible with the scale of the place, adequate shielding, glare control, and a coherent relationship between the minimum levels required for safety and the maximum levels allowed for environmental impact.

Activity support, in turn, does not consist of filling a space with fixtures to make it appear permanently active. It consists of recognizing which activities are legitimate in a given place, at what times they occur, and what physical conditions they need in order to be sustained. A pedestrian route requires visual continuity and recognizable edges; an area for lingering needs visual comfort and legibility at close range; an access point should reinforce orientation and transition; a sports venue requires concentrating light flow on the playing surface and controlling lateral spill; a facade

or an ornamental element can only be lit to the extent that it does not displace the space’s primary function or remain lit outside authorized hours. Light, therefore, must accompany real activity and not simulate activity that does not exist.

This approach has direct implications for territorial design. A space with sustained legitimate use is not built with luminaires alone, but with a combination of visibility, accessibility, permanence, and a clear reading of its component parts. Technically, this means distinguishing between functional and secondary lighting. The former should be concentrated on access points, routes, crossings, waiting areas, gathering spaces, and points where spatial orientation is critical. The latter, when present, should support the identity of the place without competing with it. This is why the regulation strictly limits flux or intensity above the horizontal plane, restricts blue emission, and regulates the brightness of ornamental and advertising elements. These requirements are not unrelated to territorial reinforcement; on the contrary, they help the night retain understandable visual hierarchies.

The concept of the edge is also important here. In CPTED, a well-resolved edge expresses transition, belonging, and legibility of place. In the context of the lighting regulation, this means that light should not spill unnecessarily onto homes, patios, open skies, or ecologically sensitive areas. Controlling light trespass and reflected emission is not only an environmental requirement; it is also a way of territorially organizing nighttime space. When a circulation zone is correctly lit, but nearby windows receive direct light or a light-colored surface reflects excess brightness, the project loses precision. Conversely, when the boundary between an area that needs light and one that does not is well resolved, the place gains legibility and quality of use.

Ultimately, territorially reinforcing a space and providing activity support does not mean artificially intensifying it, but making it more understandable, more livable, and more legitimate for those who use it. Lighting can make a decisive contribution to this goal, but only when it is subordinated to the identity of the place, to its actual hours of use, to the reading of its edges, and to the environmental requirements that Chilean regulation now clearly establishes. That is where the challenge lies: ensuring that night continues to allow for encounter, orientation, and presence, without turning the territory into an overlit, glaring surface disconnected from its own sense of place.

7

MAINTENANCE AND MANAGEMENT:

SOCIO-
ENVIRONMENTALLY
CO-DESIGNED CPTED
SUSTAINABILITY

Maintenance, within the CPTED methodology, is not a secondary stage or a purely operational issue. It is part of a space’s environmental design and concretely expresses whether a place remains legible, cared for, and appropriable by those who use it. In its most classic formulation, CPTED links maintenance to management, cleaning, and gardening plans, and highlights the importance of urban space being perceived as cared for. That perception is not a minor matter. A place with deteriorated furniture, vegetation blocking sightlines, damaged pavement, or irregularly functioning lighting conveys disorder, reduces the legibility of the environment, and weakens everyday appropriation. Maintenance should therefore not be understood as an isolated corrective action, but as a permanent condition of livability.

At night, this principle becomes even more important. During the day, certain deficiencies may go unnoticed or be partially offset by natural light and by activity in the surroundings. At night, by contrast, a poorly oriented luminaire, a dirty optic, inadequate pruning, confusing signage, or excessive contrast between lit and dark areas immediately disrupt the legibility of a space. Nighttime maintenance, therefore, is not limited to replacing equipment that has stopped working. It also involves preserving the conditions that allow people to see, find their way, recognize access points, use routes unambiguously, and sustain legitimate activities without glare or light trespass. From a CPTED standpoint, maintaining a space means keeping its

capacity for natural surveillance, access control, and territorial reinforcement active.

At this point, management becomes just as important as maintenance itself. **Managing is not only about responding once deterioration has already occurred, but about anticipating it, distributing responsibilities, scheduling reviews, and ensuring that a space’s performance does not depend solely on sporadic interventions.** CPTED sustainability cannot rest solely on a maintenance crew or a replacement tender; it also requires local knowledge, ongoing observation, and a management structure capable of incorporating the experience of those who use the place. Socio-environmentally co-designed maintenance therefore requires that the community, the client, and the technical team share criteria regarding what needs to be cared for, how often, and for what uses it should be sustained.

In the Chilean context, this dimension must also be understood in light of D.S. No. 1/2022 of the Ministry of the Environment. If a certified luminaire is replaced with a non-equivalent one, if its tilt is changed, if its scheduling control system is altered, if a projector is added without technical justification, or if the brightness of a secondary element is increased, a project can lose both functional coherence and environmental compliance. In this sense, maintaining is not just about preserving infrastructure: it is about preserving the performance of the system.

This requirement is particularly clear in the implementation scheme of the new regulation. The application of D.S. No. 1/2022 is structured around specific protocols for the certification of luminaires and projectors, on-site measurement, measurement of luminance or screen brightness, and the regularization of existing sources. All of this has a direct consequence for maintenance and management: it is not enough to simply replace equipment; it must be replaced correctly, changes must be recorded, and day-to-day operation must not undo what the original design achieved.

From a technical standpoint, this means that outdoor lighting maintenance must include, at a minimum, reviewing installation orientation and angles, cleaning optics and projectors, verifying on/off systems, controlling glare, inspecting support structures, ensuring pruning is compatible with the projected photometric distribution, and safeguarding visual continuity along routes and access points. **For ornamental, decorative, sports, recreational, and advertising lighting, management must also account for compliance with the shutdown schedules set by the regulation; and for industrial lighting, when there is no operational activity, shutdown or reduction of luminous flux should be considered as appropriate.** In this way, maintenance ceases to be a neutral practice and becomes a fine-tuning operation between actual use, safety, visual comfort, and environmental performance.

Management, in turn, cannot be separated from the material landscape of a space. A well-maintained nighttime environment depends not only on functioning luminaires, but also on pavement in good condition, legible furniture, understandable signage, well-kept vegetation, and edges that do not block observation or create residual zones. When a pedestrian route loses continuity due to raised roots, when an access point is partially hidden by shrubs, when a facade reflects excess light, or when an improvised enclosure alters the route, legibility decreases even if the luminaire remains on. CPTED sustainability requires precisely this integrated view. The maintenance of light and the maintenance of space must be considered together, because nighttime performance does not depend on a single element, but on the coherence among all of them.

8

IMPLEMENTATION IN CHILE: SPECIFICATIONS, PROCUREMENT, AND VERIFICATION

In Chile, implementing outdoor lighting projects today requires a broader perspective than simply replacing luminaires or carrying out a straightforward technology upgrade. For a long time, most interventions in public lighting were understood as maintenance, modernization, or energy-efficiency operations, often associated almost exclusively with replacing older technologies with LED luminaires. However, accumulated experience in urban safety, nighttime livability, and environmental protection shows that the problem is not solved simply by

installing newer or more efficient equipment, but by designing lighting systems suited to the place, its use, and the conditions of its surroundings. In this sense, implementation does not simply mean installing fixtures, but designing correctly, procuring with relevant criteria, and verifying that the final result effectively meets the objectives set.

From a CPTED perspective, this consideration is fundamental.

Lighting is part of a space's environmental design and therefore cannot be understood as an isolated or neutral element. Its contribution to urban safety depends on how well it allows the environment to be read, routes to be distinguished, access points to be identified, natural surveillance to be favored, and the perception of insecurity to be reduced.

At the same time, however, poorly conceived lighting can produce effects contrary to those intended: glare, excessive contrast, harsh shadows, light trespass onto homes, or a false sense of control that does not actually improve the experience of public space. For this reason, the first step of any intervention should be a proper understanding of the territory in which it will take place —its predominant uses, pedestrian and vehicular flows, hours of activity, most frequent users, and also its environmental vulnerabilities.

The tendency to apply standardized solutions has often led to oversized lighting or to configurations poorly suited to a specific place. In practice, this results in projects that prioritize the quantity of light over its quality, mistakenly assuming that increasing intensity is equivalent to improving safety. However, excessive or poorly directed lighting can reduce observation capacity, hinder facial recognition, create zones of high contrast, or negatively affect people’s nighttime experience. For this reason, design should not begin with the choice of product, but with the problem to be solved and the role that light should play within a broader strategy of situational prevention and urban livability.

Within this framework, technical specifications take on decisive importance. **Proper implementation requires a project to clearly define the characteristics of its lighting system, not only in terms of efficiency or durability, but also in terms of its environmental and visual behavior.**

Current Chilean regulation has helped structure this discussion by setting requirements that account for the direction of light, the limitation of flux toward the upper hemisphere, spectral composition, color temperature in certain cases, scheduling control, and other aspects related to the emission and impact of outdoor lighting. This means that specifications can no longer be formulated generically, as was often the case when it was enough to indicate wattage, luminaire type, or the technology used. Today it is necessary to include information on photometric distribution, mounting conditions, orientation, height, shielding, and compatibility with the territorial context in which the project will be located.

This requirement becomes especially relevant in procurement processes. Technical bidding documents should not be limited to requesting certified equipment or describing minimum catalog specifications; they should instead allow for the procurement of comprehensive lighting solutions. This means requiring that the design respond to a clear objective, that the proposed equipment be appropriate for the intended use, and that technical documentation allow its behavior to be anticipated once installed. A correctly certified luminaire can nonetheless produce a poor result if it is mounted at an inadequate tilt, installed at an improper height, spaced too far from other light points, or ends up projecting luminous flux toward homes, sensitive areas, or surfaces that generate unwanted reflection. The quality of a bidding process, therefore, does not

depend solely on how precisely a fixture is described, but on the ability of the bidding documents to link the product with the project, its installation, and the expected overall performance.

For municipalities, public agencies, contracting companies, and private clients, this shift has concrete implications. Under the new regulatory and technical framework, a project’s compliance cannot be based solely on a supplier’s declaration or on general references to applicable standards. It becomes essential to have sufficient documentary and technical traceability to demonstrate that what was designed corresponds to what was installed, and that what was installed meets the applicable requirements. In this scenario, Chilean institutions have been moving toward a more preventive approach, in which certification, technical protocols, on-site inspection, and reporting mechanisms take on a central role. This is particularly important because it shifts the discussion from a discursive level to a verifiable one. It is no longer enough to assume that a solution is adequate simply because it is new or efficient; it must be demonstrated that it meets the required conditions and that its actual performance does not generate adverse effects.

The deadlines for the regulation’s entry into force and compliance further reinforce the need to plan ahead. Decisions that municipalities, concessionaires, and private parties make today regarding investment, procurement, and equipment replacement will have medium-term effects and can

result in unnecessary costs if current requirements are not considered from the outset. A poorly specified project can not only affect the quality of the space involved, but also require subsequent corrections, premature replacements, or avoidable regularization processes.

Ultimately, implementing outdoor lighting in Chile means recognizing that it is a sensitive form of infrastructure, one that directly affects urban safety, the perception of insecurity, nighttime livability, and environmental protection. The challenge, therefore, is not only about having access to better technologies, but about designing better, procuring better, and verifying better. Only in this way can lighting become a genuine contribution to public space, rather than an additional source of environmental deterioration or poor urban quality.

CONCLUSIONS

The development of this booklet supports the assertion that the relationship between urban safety and the protection of the nighttime environment can no longer be understood as though these were separate domains. The CPTED methodology and light pollution prevention now converge on a shared concern: how to design, manage, and maintain urban spaces that are legible, livable, and safe for people, without producing unnecessary impacts on human health, biodiversity, and the quality of the night sky. At this intersection, the night ceases to be a residual time of the city and becomes a fundamental dimension of contemporary urban design.

One of the main ideas running through this document is that nighttime safety does not simply depend on increasing the amount of available light. Technical experience and CPTED's own logic show that excessive, poorly directed, or poorly maintained lighting can undermine natural surveillance, hinder orientation, produce glare, and negatively affect the perception of space. The challenge, therefore, is not to light more, but to light better. Light must provide useful information for recognizing routes, access points, edges, and legitimate uses, without becoming an additional source of visual disorder or environmental pollution.

In this context, Supreme Decree No. 1/2022 of the Ministry of the Environment represents a substantive shift in how outdoor lighting is approached in Chile. Its significance lies in the fact

that it broadens the scope of protection beyond astronomical observation, explicitly incorporating human health and biodiversity. In doing so, it requires shifting the discussion away from a view centered on technology replacement toward a more complete understanding of a space's lighting performance. Outdoor lighting must be considered in terms of its direction, spectral composition, reflected emission, scheduling control, and territorial suitability. This requirement is fully compatible with a third-generation CPTED approach, in which safety, sustainability, and livability are part of the same conversation.

Throughout this text, it has been shown that classic CPTED principles take on a different depth when applied to nighttime space. Natural surveillance requires useful visibility without glare. Natural access control demands clear routes, legible thresholds, and understandable spatial hierarchies. Territorial reinforcement and activity support depend on light accompanying the identity of a place and its real uses, without overlighting it. Maintenance and management, in turn, cease to be purely operational matters and become permanent conditions of livability and environmental performance. In all of these cases, lighting does not appear as a neutral resource, but as a design tool that must act with precision and clear limits.

It is also evident that implementation is today one of the main challenges.

Good design is not enough if specifications are weak, if procurement processes fail to account for the system's actual behavior, if installation deviates from what was designed, or if subsequent maintenance undoes the logic of the design. **Technical training, institutional coordination, and compliance traceability are therefore essential.** The joint contribution of Fundación Cielos de Chile and CPTED/ICA makes it possible to move precisely in that direction: integrating urban safety and the protection of the nighttime environment into a single perspective, capable of guiding more rigorous and more responsible decisions about the future of our cities.

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