Interreg CENTRAL EUROPE

Co-funded by the European Union

DARKERSKY4CE

Transnational Strategy

The Future of Dark Skies in Central Europe

Executive Summary

2026



Project Title	DARKERSKY4CE – Strategic Transnational Approach to Reduce Light pollution in Central Europe
Project ID and Acronym	CE0200765 - DARKERSKY4CE
Authorship	Light Pollution Think Tank
Authorship Acronym	LPTT
E-mail	kontakt@lptt.org.pl
Reviewers (alphabetical order)	Remy Baltieri (Italy) Dario Barghini (Italy) Balazs Borkovits (Hungary) Katarina Danjski (Slovenia) Roman Hillebrand Lauterborn (Germany) Andrzej Kotarba (Poland) Agata Mazurek (Poland) Rafał Modrzewski (Poland) Marta Polizzi (Austria) Krystyna Skwarło-Sońta (Poland)
Contributors (alphabetical order) **Affiliation** [1] Nicolaus Copernicus University in Toruń [2] Maria Curie-Skłodowska University in Lublin [3] University in Wrocław [4] University of Agriculture in Kraków [5] POLARIS-OPP Association [6] Polish Academy of Sciences in Kraków [7] University of Gdańsk [8] Cracow University of Technology [9] Łódź University of Technology	Dominika Daab[1] Grzegorz Iwanicki[2] Sylwester Kołomański[3] Anna Kołton[4] Mieczysław Kunz[1] (leader) Agnieszka Machnowska[5] Julia Nawalkowska[5] Piotr Nawalkowski[5] Karolina Skorb[6] Katarzyna Szlachetko[7] Tomasz Ściężor[8] Przemysław Tabaka[9]

Acknowledgments

This document is part of the INTERREG Central Europe project “DARKERSKY4CE - Strategic Transnational Approach to Reduce Light pollution in Central Europe”. The project is supported by the Interreg CENTRAL EUROPE Programme 2021-2027 with co-financing from the European Regional Development Fund (ERDF). The project total budget is 1,791,013.00 EUR.

Disclaimer

This publication has been developed within the DARKERSKY4CE project, supported by the Interreg CENTRAL EUROPE Programme with co-financing from the European Union. Its content is the sole responsibility of the authors and the project partnership and does not necessarily reflect the views or positions of the Interreg CENTRAL EUROPE Programme, its programme bodies or the European Union. Neither the programme authorities nor the European Union can be held responsible for any use that may be made of the information contained herein.

Purpose and Scope of the Transnational Strategy — the future of dark skies in Central Europe

Artificial light at night is currently one of the fastest-growing sources of environmental pressure in Europe. Ongoing urbanisation, the expansion of technical and transport infrastructure, and the increasingly widespread use of outdoor lighting are driving a systematic rise in light pollution. This phenomenon affects not only the functioning of ecosystems but also human quality of life and the perception of the nocturnal landscape. In Central Europe, the issue assumes particular significance, as it encompasses both densely populated and highly urbanised regions, as well as extensive natural areas, including valuable and protected sites that have retained a high quality of the night sky.

The *Transnational Strategy - the future of dark skies in Central Europe* has been developed within the framework of the DARKERSKY4CE project as an instrument to support coordinated actions aimed at reducing light pollution across the nine countries participating in the Interreg Central Europe Programme. The document responds to the need to establish a common approach to the protection of the nocturnal natural environment in the context of the diverse legal, spatial and social conditions characterising individual European countries.

The primary objective of the strategy is to identify directions for action that enable the effective reduction of artificial light pressure while maintaining the functionality of outdoor lighting. Particular emphasis is placed on the protection of nocturnal ecosystems and the natural night sky, commonly referred to as “dark skies”. The document highlights the importance of preserving the natural nocturnal landscape as an element of the region’s natural and cultural heritage.

An important component of the strategy is the identification of development potential arising from dark sky protection, particularly in the context of astro-tourism and other forms of educational and experiential tourism. Areas characterised by high-quality night skies, especially rural and protected areas, may constitute a significant economic asset for local communities, supporting economic diversification and strengthening local territorial identity.

The *Transnational Strategy - the future of dark skies in central Europe* also takes into account the growing number of local conflicts associated with the installation of new artificial lighting sources and the transformation of the nocturnal landscape. In this regard, it proposes forms of cooperation between public administration, managers of protected areas, the tourism sector, spatial planners, researchers, and local communities in order to develop solutions that balance the needs of technical infrastructure development with the protection of the nocturnal environment.

The scope of the strategy includes the identification of key challenges related to light pollution in Central Europe, a review of existing legal frameworks, and a set of strategic

recommendations and directions for action that can be implemented at the local, regional and national levels. The document is based on an analysis of regional reports, the outcomes of working groups established under the DARKERSKY4CE project and implemented in six partner countries, the international body of literature on the subject, and the interdisciplinary experience of the authors representing various institutions and sectors.

The transnational nature of the strategy facilitates the exchange of knowledge, good practices, and the development of joint actions aimed at reducing light pollution. In the longer term, the document is intended to support the strengthening of the region's environmental, social and economic potential through the protection of the night sky as a shared asset of Central Europe.

The protection of dark night skies does not imply the abandonment of outdoor lighting, but rather its rational, purposeful and responsible use, with due regard for human needs, safety, public health and nature conservation.

Executive Summary

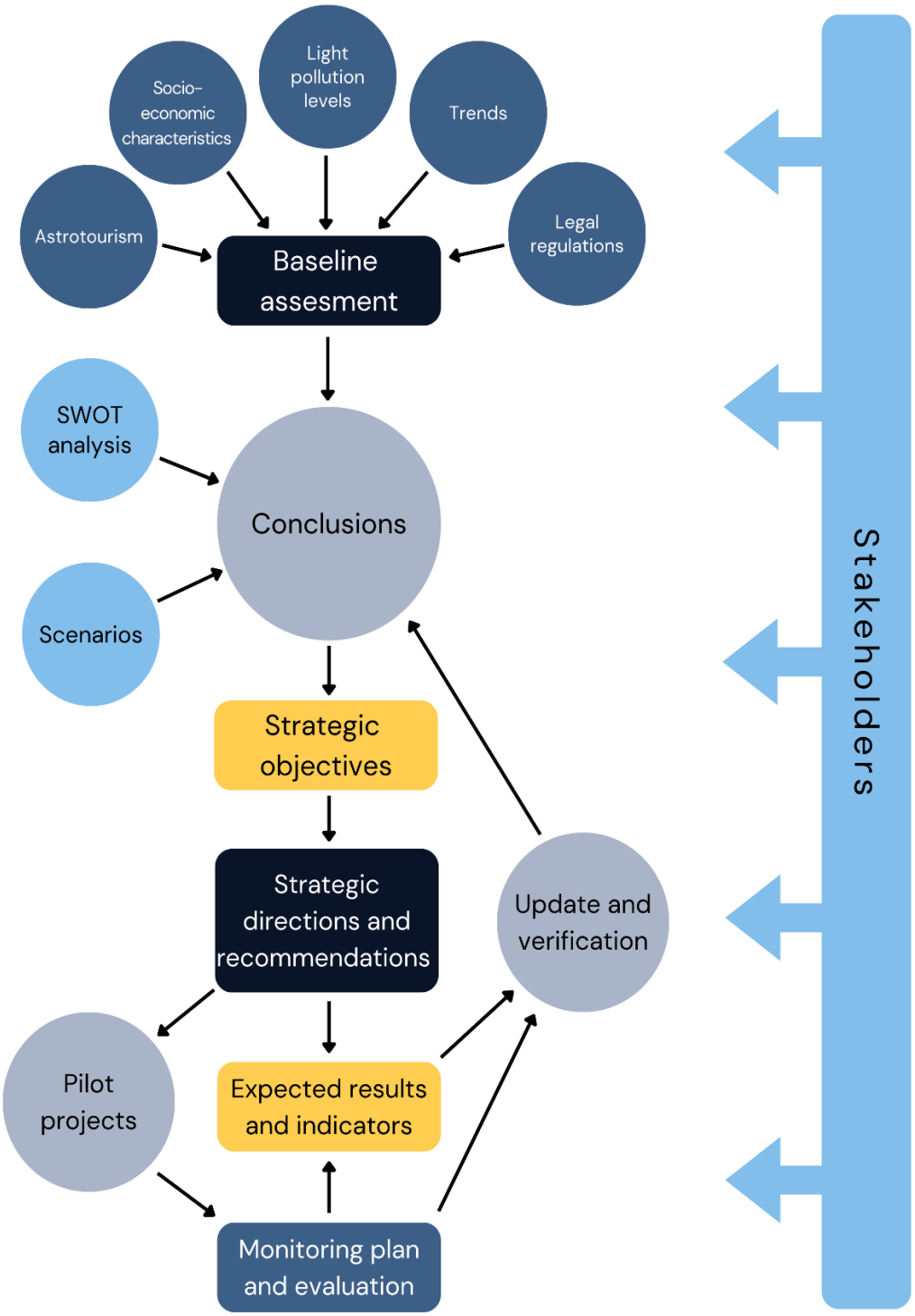
Introduction

The *Transnational Strategy - the future of dark skies in Central Europe*, developed under the DARKERSKY4CE project, constitutes a comprehensive strategic document supporting coordinated actions aimed at reducing light pollution across the nine countries covered by the Interreg Central Europe Programme.

Light pollution is a form of environmental pollution caused by artificial lighting, negatively affecting human health, ecosystems, landscapes, and astronomical observations. Outdoor lighting infrastructure plays a key role in determining the impact of light pollution, as artificial light spreads through the atmosphere and affects areas far from its sources. As a result, naturally dark night skies are becoming increasingly rare, especially in densely populated regions. Light pollution is growing globally due to both intensification of existing lighting and expansion into previously unlit areas. This widespread and transboundary problem is further driven by the use of poor-quality lighting and insufficient public awareness of its environmental impacts. Because its impacts extend across borders, effective mitigation requires international cooperation. Dark sky protection delivers tangible benefits for human health, ecosystem stability and economic development. Reducing light pollution supports biodiversity, improves quality of life, and enables the development of sustainable tourism. It also represents an important element of efficient energy and resource management.

The primary objective of the strategy is to identify directions for action that enable the effective reduction of artificial light pressure while maintaining the functionality of outdoor lighting.

During the preparation of the strategy, an in-depth analysis of the current situation (Baseline assessment), a SWOT analysis, and a future scenarios analysis were conducted; various types of stakeholders collaborating within the Interreg DS4CE project were involved in each of these analyses. Following these analyses, conclusions were drawn, which served as the basis for developing the strategic objectives. Next, strategic directions and recommendations were established. Expected outcomes and indicators were identified, and a monitoring plan was proposed. All of these elements are presented in the diagram below. Additionally, the diagram indicates that, following the completion of pilot projects and further consultations with stakeholders, an update and verification should be conducted. It is possible that modifications resulting from updates will occur during the implementation of the strategy. The strategy should be “living/dynamic” and may be partially modified during implementation.



Components of the Study Constituting the *Transnational Strategy - the future of dark skies in Central Europe*

Diagnosis

Monitoring and satellite data confirm a **continued increase in light pollution across Central Europe between 2015 and 2023**, consistent with global trends. The transition from older outdoor lighting (mainly sodium and metal halide lamps) to LED-based

lighting may partly contribute to this trend. The main sources of artificial light, and therefore light pollution, include urban areas, airports, industry, and logistics infrastructure. At the same time, relatively dark regions suitable for astro-tourism still remain. **Dark sky protection** in Europe and worldwide remains **fragmented** and **inconsistent**, relying mainly on indirect and often non-binding regulations, despite growing awareness of its importance for the environment, public health and cultural heritage. Astro-tourism is developing steadily in Central Europe, supported by growing efforts in dark sky protection. More than **20 certified dark sky places** operate across the region, including the pioneering cross-border dark sky parks in the Izera Mountains and the Beskids, as well as the unique tri-border dark sky area in the Bieszczady Mountains. The region offers a diverse range of astro-tourism products, including dark sky parks and reserves, observatories, educational centres, astronomy outreach events, and communities implementing policies aimed at reducing light pollution. However, the sector's development is hindered by the fragmentation of initiatives, the absence of common standards, and limited cooperation in promotion and marketing activities. At the same time, the growing demand for niche tourism and increasing awareness of environmental protection create favourable conditions for the further expansion of astro-tourism. In particular, cross-border products and the establishment of a "Dark Sky Region" cluster offer significant potential by enabling joint promotion, service standardisation, infrastructure development, and the creation of a strong and recognisable regional brand.

SWOT analysis

In order to ensure the effective, responsible and sustainable protection of dark skies in Central Europe, a SWOT analysis was conducted. Strategic factors were identified in terms of threats (T) and weaknesses (W), as well as strengths (S) and opportunities (O), relating to the potential for strengthening dark sky and nocturnal biodiversity protection, the development of astro-tourism, and social cooperation aimed at reducing light pollution. Methods for leveraging current trends and opportunities, as well as using strengths to mitigate risks and minimize weaknesses, have been presented. Although the current timing is favourable for dark sky conservation efforts, there is a **lack of stable, long-term financial and legal mechanisms**. It is essential to **strengthen cooperation between sectors and regions** and to conduct intensive **educational activities** to expand the number of qualified personnel.

Target groups and stakeholders engagement

The future of dark skies in Central Europe depends to a significant extent on the identification of key target groups and the mechanisms through which they are engaged in the protection and sustainable use of dark sky resources. The effective implementation of the strategy requires a **multi-sectoral approach**, based on **cooperation among public administration, the tourism sector, scientific institutions, non-governmental organisations, local communities, and private entities**. The

Transnational Strategy provides a detailed identification of stakeholders and target groups of the strategy (drawing also on thematic reports developed by working groups, as well as on practical experience and expert reflection), defines the relationships between them, and outlines the forms of their engagement in the implementation process.

Strategic objectives

The main objective—**the long-term protection of dark skies**—was presented, which depends on actions in three thematic areas:

- the protection of nocturnal ecosystems,
- local and transnational cooperation,
- the sustainable development of tourism.

The relationships between the objective and the thematic areas were illustrated, and strategic objectives were defined for each thematic area: **(1)** to preserve high levels of biodiversity and natural night-time conditions by halting the increase in light pollution in Central Europe, **(2)** to develop an effective strategy for promoting existing astro-tourism sites and establishing new dark sky places in areas with the highest potential for astro-tourism development, **(3)** to support and activate community self-organization for the reduction of light pollution. It was noted that achieving the strategic objective requires the implementation of specific objectives across various time horizons.

Scenarios for dark sky protection

As part of the preparation of the strategy for dark sky protection in Central Europe, a strategic foresight analysis was conducted. Its objective was to identify possible development pathways for the protection of nocturnal ecosystems and to determine the factors that may influence the scale of light pollution in the future. The developed scenarios—**status quo and pessimistic—do not enable the achievement of the strategic objectives** defined for each thematic area. In such cases, the focus shifts primarily to preventive rather than corrective measures, aimed at avoiding further deterioration of the current quality of dark skies in Central Europe. **Only the optimistic scenario enables the achievement of the defined strategic objectives** and therefore should be actively supported through the implementation of the proposed measures. The optimistic scenario demonstrates that it is possible to stop the increase in light pollution, if the EU policies are harmonised, smart lighting technologies are developed, urbanisation processes are moderated, and long-term public education is implemented. The most effective outcomes result from **combining legal, technological and social actions**.

Strategic directions and recommendations

The document presents a comprehensive set of strategic directions and recommendations aimed at the effective protection of the dark sky in Central Europe. Building on the conclusions of the SWOT analysis and a scenario-based approach, the

document structures actions across **six** mutually reinforcing areas: **strengthening institutional and financial mechanisms; legal regulations and spatial planning; the development of monitoring systems; education and public awareness; sustainable night-time tourism; and climate policy.**

The key message of this document is the need to move from reactive and fragmented measures toward a **proactive, coordinated, transnational, and systemic approach engaging local governments, public institutions, the private sector, the scientific community, and local stakeholders**. The protection of the night sky is framed not as a constraint, but as a **resource**—environmental, health-related, cultural, and economic—whose **rational management** requires common standards, durable partnerships, and modern tools for the governance of lighting infrastructure.

Outcomes

In the final part, the expected outcomes of measures aimed at the protection of the dark sky in Central Europe are defined and specific indicators are assigned to them for their assessment. A two-level classification of outcomes was introduced—**soft outcomes**—relating to knowledge, competencies, and institutional readiness—and **hard outcomes**, verifiable through documents, systems, and implemented solutions. This distinction is of key importance for realistic planning. Rather than formulating distant, long-term civilizational objectives, focuses on outcomes that are directly attainable by identified stakeholders within a defined time horizon.

The strategy also includes detailed directions for action and recommendations, covering, inter alia, the development of legal regulations, the implementation of modern and energy-efficient lighting technologies, public education, and the strengthening of cooperation among countries in the region. It further specifies the expected results, indicators for their achievement, and a system for monitoring the progress of implementation.

Monitoring plan

The monitoring plan is designed to assess the effectiveness and progress of implementing the strategy using an indicator-based approach and continuous data collection. It focuses on tracking changes in light pollution levels, policy implementation, and stakeholder engagement, including public awareness and astro-tourism development. The results are to be reported **annually** and reviewed **periodically** to support adaptive decision-making and updates to the strategy.

The document highlights the importance of protecting the natural **nocturnal landscape** as a significant component of Central Europe's **natural and cultural heritage**. It is complemented by descriptions of pilot projects implemented under the DARKERSKY4CE project, which provide practical examples of the implementation of the proposed solutions and form a basis for the further development of measures aimed at protecting dark skies in the region.