

DARKERSKY4CE

Dynamic Monitoring Tool



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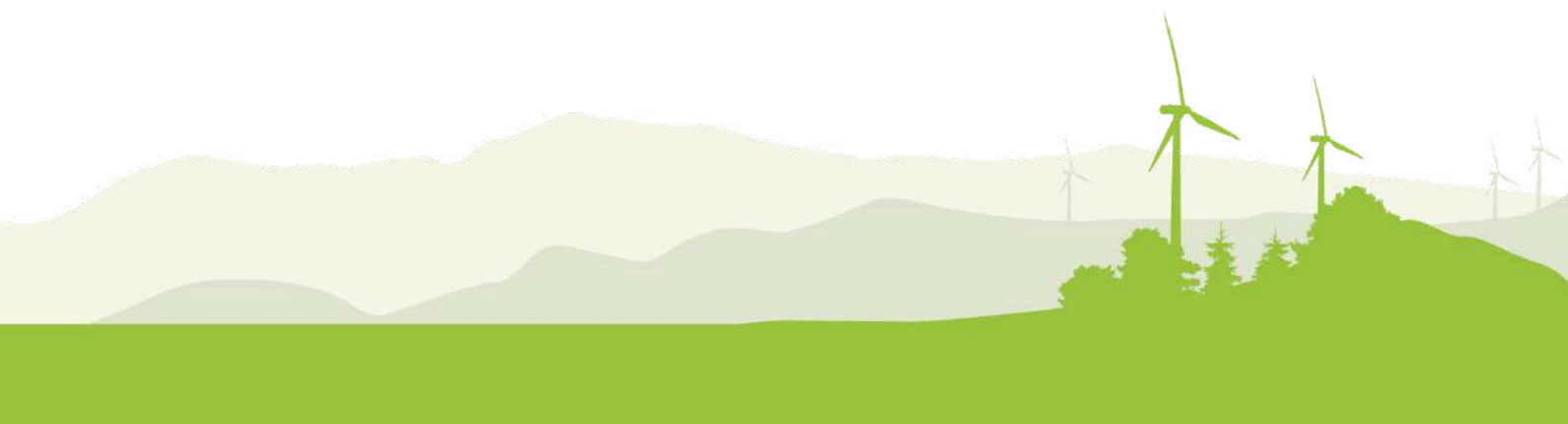




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Purpose and Scope of the Dynamic Monitoring Tool

The Dynamic Monitoring Tool (DMT) is a system built by the DARKERSKY4CE project to measure the change activated by its activities at the beginning, during and upon its closure and beyond.

The DMT can be useful also for other projects or groups that want to assess the impact of their work on reducing light pollution, but can be adapted as a tool for other similar types of action.

What is to be measured is:

- the change in the perception of the threat posed by light pollution
- the change in the assessment of the ecosystem value of dark skies
- the actions put in place by stakeholders to transform dark skies into an asset for sustainable local development.

These three dimensions are linked to provide a full overview of the challenge tackled, being functional to project objectives and sustainability, providing a basis for action, to tackle the issue with a reduction of lights or remodel to environmentally friendly light systems. They are investigated in different tools directly or indirectly.

It analyses which tools are best to use, which target groups are most important to reach and which indicators can be used to achieve the set objectives.

Three different types of tools were selected to compose the DMT: surveys, calls to action and desk research. For each of these, the reason for their selection, their use and the objective to be achieved will be analysed. In addition, concrete examples will be provided to better understand their use.



Acknowledgments

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1. The Dynamic Monitoring Tool

1.1 Identify the target

Light pollution is an increasing threat in terms of ecological sustainability, with effects on environments, plants and animals. Even human health can be subtly affected. However, the increasing scientific evidence of the concerns posed by the excess of artificial lighting does not correspond to an increase of public awareness, contrary to other sources of pollution.

The actors on the light pollution scene are different: the general public, economic operators, public administrators, entities directly influenced by lighting such as astronomical observatories, and so on. All of them can both suffer from the consequence of light pollution, as well as provoke an increase of it.

In the framework of the DARKERSKY4CE project, we choose to address our effort to selected targets: general public, school students, public administrators.

Citizens are an important target, primarily because the change in the perception of the light pollution threat must be as deep and wide as possible, but also because their opinion can drive administrators' choices. Among them, economic operators are of particular interest because they can both be a source of artificial lighting misuse, and suffer from its effects. Moreover, astro-tourism can be an interesting asset for local economic development, especially for rural areas.

School students are a sensitive audience, they are inclined to address the issue of nature conservation in its various forms, and it is important to fill the information gap on light pollution.

Finally, public administrators have the responsibility, but also the tools to implement the change, both by educating the population and by acting on the regulations and their practical application.

These desirable targets are very different from each other, and they should be reached in different ways. For citizens, social media are the preferred way, together with targeted actions such as public events or contacts with associations sensitive to related topics. With students, it is possible to take structured and interactive activities, like cycles of laboratories or conferences during school time, and to directly follow the change in the attitude of young people toward light pollution.

Public administrations, or similarly entities with decisional power should be contacted in a more direct mode, to properly present the issue, to help with obstacles that can arise, such as regulations, or to share good practices implemented elsewhere.

1.2 Research and choose the tools

In the scientific literature, it is possible to find works that address the topic of the subjective approach of different parts of the population to the light pollution subject, ranging from health issues and degradation of the overall life quality to social reflection such as requests for regulations.



The preferred tool to conduct this investigation, especially in the research field, is the survey. It is an immediate way of communication with people, it can be spread among different layers of the population with several media, and it can be tailored to address different aspects of the light pollution issue with a fair amount of depth.

The following examples are investigations about different aspects of light pollution effects. A survey conducted in Finland in 2013¹ was aimed to investigate which aspects of lighting are considered harmful by the population, with focus on urban, on average well-educated people, finding how surprisingly the health and ecological effects were less felt than the recreational and cultural ones. A 2020 Irish study² was focused on human sleep and animal behaviour effects, and it collected answers from a more diverse population, highlighting the importance of geographical placement. Rural people reported more sleep disturbances, while urban residents were more worried about wildlife changes. A Korean research work³, in 2014, linked the level of risk perception of different types of artificial lights to psychometric variables, and how communication on risks is perceived by different respondents.

There are also limitations, when using a survey. While it is quite easy to reach a certain number of respondents, not all of them will start to answer it, and even less will complete filling it. The interviewed sample should fulfil some requirements of representativity of the target population, with a random selection criterion and sufficient sample dimension. The filling requires some time and attention, and the answers must be carefully written and post-analysed to identify false answers, preconceptions, biases.

To sum up, if we want to monitor with some depth the change posed by the light pollution, both in its perception as a menace for species and in the assessment of the value of dark skies, the questionnaire is an adequate tool to get detailed pictures of people's feelings, and to analyse variations.

However, since we also want to reach a wider audience and make them interested in learning more about the light pollution issue, we have explored other tools, typical of social media.

Sponsorships and call-to-actions are the most widely used marketing tools in the world of the web.

The 'call to action' (CTA) is used in web marketing to 'call users to action', and it is an essential tool for guiding users and improving engagement, but also for measuring the

¹ Lyytimäki J, Rinne J, "Voices for the darkness: online survey on public perceptions on light pollution as an environmental problem", *Journal of Integrative Environmental Sciences*, vol. 10, n. 2, 2013, <http://dx.doi.org/10.1080/1943815X.2013.824487>

² Coogan, A et al, "Perceptions of Light Pollution and its Impacts: results of an Irish Citizen Science Survey", *International Journal of Environmental Research and Public Health*, 17, 5628, 2020, doi:10.3390/ijerph17155628

³ Kyung Hee, K et al, "A study on the risk perception of light pollution and the process of social amplification of risk in Korea", *Environment Science Pollut Res*, 2015, 22, doi:10.1007/s11356-015-4107-5



effectiveness of campaigns. It is therefore a clear and direct invitation to perform a certain action. The action should be immediate, such as clicking on a link, filling in a form, making a purchase or seeking further information. The type of action requested determines the techniques to be used.

The Call to Action can be the phrase or the button that closes a post on the site or social profiles, or on a landing page, etc.

Since the effectiveness of a CTA depends on its ability to both enlighten the value of the proposed action and facilitate the user interaction, it must be clear, concise and visible; posts often use eye-catching colours and strategic positions to attract attention.

The quantity of interactions can be measured to evaluate the effectiveness of the published content, its capacity to channel people's attention toward the objectives of the project.

For example: a published post will be viewed by a certain number of users and will invite them to a 'call to action'. Depending on their interaction, the actual degree of involvement, i.e. interest in the topic and feelings, can be assessed.

These kinds of interactions with people can become effective for our research, as they allow us to monitor the current knowledge of the ALAN, the interest in deepening the knowledge, and the change in the overall perception over time.

In order to succeed in engaging social audiences, who are mostly distracted by countless cues related to their real and presumed interests, and to be able to assess by means of specific indicators the degree of interest and knowledge of ALAN, it is necessary to try to 'attract' and 'channel' targeted segments of the population towards our content with ad hoc constructed posts and videos.

Since we are dealing with a niche topic, we will use geotargeting sponsorships, i.e. the promotion of 'posts/videos' to a target audience, chosen based on their interests, on the main social channels such as Instagram and Facebook. With this tool it will be easier to collect large-sized samples of data.

Sponsorship is a repeatable form of investigation, but it is essential to maintain the same modalities such as length of publication, choice of target audience and geographic area, social channels and methods used, so that data can be compared.

Finally, the third objective of the Dynamic Monitoring Tool is to monitor the activities put in place locally to make dark skies attractive for sustainable development.

This point can be analysed in part using surveys, particularly if addressed to local administrators. Moreover, a desk research model can help to understand how active stakeholders in a given area are on a specific issue, in this case light pollution/dark sky protection and related topics (astronomy, astrotourism, night nature preservation, etc.).

This last tool has the advantage of requiring few resources in terms of time and money, and provides a snapshot of the activities underway in a given area and the actors already



working on them. It can be used by operators, but also by interested but inexperienced people, giving them advice on the keywords or tags to be used to finalize the research.

2. How to develop the tool

This chapter gives a description of the general characteristics of the tools developed by DARKERSKY4CE, in particular the questions we want to prioritize for surveys, the type of actions identified for the Call to Action, both with their indicators of the change, and finally how to guide users in their research on local activities related to light pollution.

2.1 Surveys

Surveys can cover different aspects of the light pollution issue.

For the DARKERSKY4CE project, we want to monitor changes in the population attitude toward this threat, so we focus especially on questions that can be statistically analysed with indicators able to understand if a change occurred. However, other characteristics of the population can be of interest, in order to categorize answers and have a more in-depth view.

We can identify some categories of questions, with their indicators.

1) *The knowledge of the light pollution issue.*

We can investigate if people have already heard about light pollution.

A typical indicator for the change is the percentage of people aware of the issue: we expect it to rise.

Moreover, knowing through which information channel the audience learned about artificial light at night can help identify the most used channels and use them to effectively communicate news about project events, the DARKERSKY4CE Call to Action, etc.

2) *The presence of artificial lighting in common life.*

Artificial lights are ubiquitous and people get used to their presence. Survey's questions can help focus on:

- what are the most predominant source of lights (streetlights, residential and/or commercial lighting, traffic, private houses indoor/outdoor lighting, transitory lights such as festivals or night events)
- if they changed in the last years: is people paying attention to the level of lighting?

Answers can help describe the source of artificial lights, linked to the geographical area of the respondent. Indicators for the change are linked



especially to the rise of the level of people's awareness and attention to the surrounding environment.

3) *The feelings about the effects of artificial lighting.*

The effects of artificial lighting on the natural environment and its species are still poorly accepted by the population, while they are described in an ever-growing literature. Questions can cover the following topics:

- how artificial light affects human health: the pre-sleep habits (such as exposure to white artificial light), the sleep quality, as perceived by people
- how it affects animal behaviour: the quantity of nocturnal species around inhabited areas, as perceived by humans, but also the knowledge of effects of light pollution on wild species
- the effects on ecosystem services, i.e. the benefits that natural ecosystems provide to human society, both directly and indirectly. ALAN can have negative effects, for example on pollinators, reducing their capacity to provide food, on aquatic species, varying their habits and natural cycles.

Answers to these questions can give an insight of the perception of the negative effects of light overexposure on human health, and on the natural environment we are living in.

Indicators for the change are, for example, the percentage of people aware that light pollution has effects on nocturnal species, and what they are.

4) *Is artificial lighting beneficial for humans?*

In the common sense, the light is often considered a form of progress, and closely linked to security and to nightlife entertainments. We can investigate what are the perceptions about:

- the usage of artificial light for commercial purposes: advertising, in commercial centres or along streets, but also for night clubs
- the usage of artificial light for cultural purposes: monuments, historic buildings
- the personal feelings when crossing dark areas
- the correlation between crime and lighting: although in the literature this correlation is not clearly proved, this is not what people generally think. More light makes them feel more secure.

For these questions, there are different indicators for change.

For the commercial use of lighting, it is important to understand the thoughts of commercial operators, checking the percentage of whom who think that the lighting of their premises is essential for sales, but also of whom who are willing to install sustainable lighting, or already did it.

For the security issues, we can monitor the percentage of people that associate more light to more security, but also work with public administrations, who typically are in charge of the public lighting (including cultural buildings). Their



willingness to introduce the light pollution issue in the decision process is often subject not only to technical difficulties, but also to electoral evaluation.

Indicators can easily monitor the level of knowledge of local regulations, their applicability subject to financial constraints. They can also check for political willingness, even if the analysis of these latter indicators is difficult because it is influenced by hidden variables such as electoral expectations.

5) *Cultural aspects*

Dark skies are connected to night experiences such as astronomical observations (both professional and amateur) or nocturnal events such as walks, discovery of night environments, and so on. We can have questions about:

- the availability of starry skies in the living area (linked to geographical information of the respondent)
- the awareness of the benefits of dark sky experiences on physical and mental health. This has to be recognized as a cultural ecosystem service, for its positive effects on physical and mental health.
- the knowledge and attitude toward astro-tourism and other sustainable economic activities

Indicators for the change can monitor the percentage of people already aware of the importance of dark skies, of those available to experience a sustainable tourism involving dark skies.

6) *Are people willing to change?*

The sensitivity toward the light pollution issue should tend to a change in habits. We can have questions about the willingness to change in:

- private context: outdoor lighting, participation to public events, availability to support campaigns for public interventions
- public context: local public lighting, local regulations, support for national ones.

For this case, indicators for change can monitor the types of public and private illuminations used, the percentage of private and public institutions willing to update their source of illuminations, or that already did.

Finally, a set of questions not directly related to indicators of the change in perceptions are useful to further interpret the respondents' way of thinking. In compliance of the current privacy regulations, in this set of personal information we can ask for:

- gender, age, qualification
- geographical position of respondent: we can expect different approaches from people coming from rural or urban areas
- attitude towards environmental sustainability, to understand the background of respondents



This additional information can be used to categorise data provided that each category is sufficiently numerous.

2.2 Call to action

Analysing the type of CTAs usually proposed for commercial purposes, we came up with a series of proposals with purposes mainly related to data collection and measurement by means of specific indicators, but also with entertainment functions and insights into the ALAN theme.

Generally, the main objective of CTAs is to convince people to visit the so called *landing page*: generally a page of a website built with the specific purpose of converting visitors into 'leads', i.e. people potentially interested in purchasing the service offered. In our case, this translates into a page where concrete action can be performed by the users: download informative material on light pollution and/or on related projects, request information, leave a contact number, register to events and share materials and information.

To assess the effectiveness of the landing page, it is necessary that the action requested to the user is measurable: it is very important, in fact, to understand how many actions have been generated after correctly channelling visitor traffic to the landing page via a direct link.

The final landing page envisaged as the closing of the individual CTAs, is therefore a web page (or post) that engages the user by prompting them to take specific actions, in our case to share or learn more. It must be clear, direct and without distractions.

Examples of suggested actions to redirect users to the Landing page:

Share → Social button or share (Facebook, Instagram, LinkedIn, Spotify)

Read more → Link to a brief explanation of the ALAN problem with an infographic or link to a specific section of the Darkersky4ce website

Get actively involved → "Want to help protect the dark skies? Here are some concrete actions you can do!" e.g. a checklist of concrete actions you can take, or the participation to some citizen science project filling surveys or collecting evidences of light pollution, *or refer to the website and/or newsletter*

Stay connected → Subscribe to the newsletter (to find out if you will be the eventual winner of the prizes provided) or to receive updates and tips

To broaden our survey through CTAs we therefore need to use social channels as they allow us to reach a larger and more targeted audience.

Sponsorships, i.e. the promotion of 'posts/videos' inviting the CTA can be proposed as a tool during light pollution related activities, the most suitable being Instagram and Facebook. Social channels such as LinkedIn, Spotify and YouTube provide accessibility to the content proposed by the CTA by means of special links in the posts or landing pages.



It is also very important to maintain a consistent stylistic and graphic format in order to give recognisability to the CTAs proposed by our project, both because they will be used on different channels and because they will be proposed at different times.

Figure 2.2.1 shows a list of different typologies of CTAs that guide the user to the landing page, where they can do several actions. The scheme is quite general, and easily adaptable for different projects. The particular implementation for the DARKERSKY4CE project foresees:

1. short and fun quiz “*discover what animal of the night you are*”
2. short surveys on Instagram, stories and posts
3. receive a “*Win a night among the Stars*” prize if you fill in our questionnaire
4. competition “*Discover the darkest sky*” - citizen science project
5. podcast “*Listen to the Stars*” on Spotify
6. video “*Is the dark scary or good?*” on Youtube

More details are available in chapter 3.

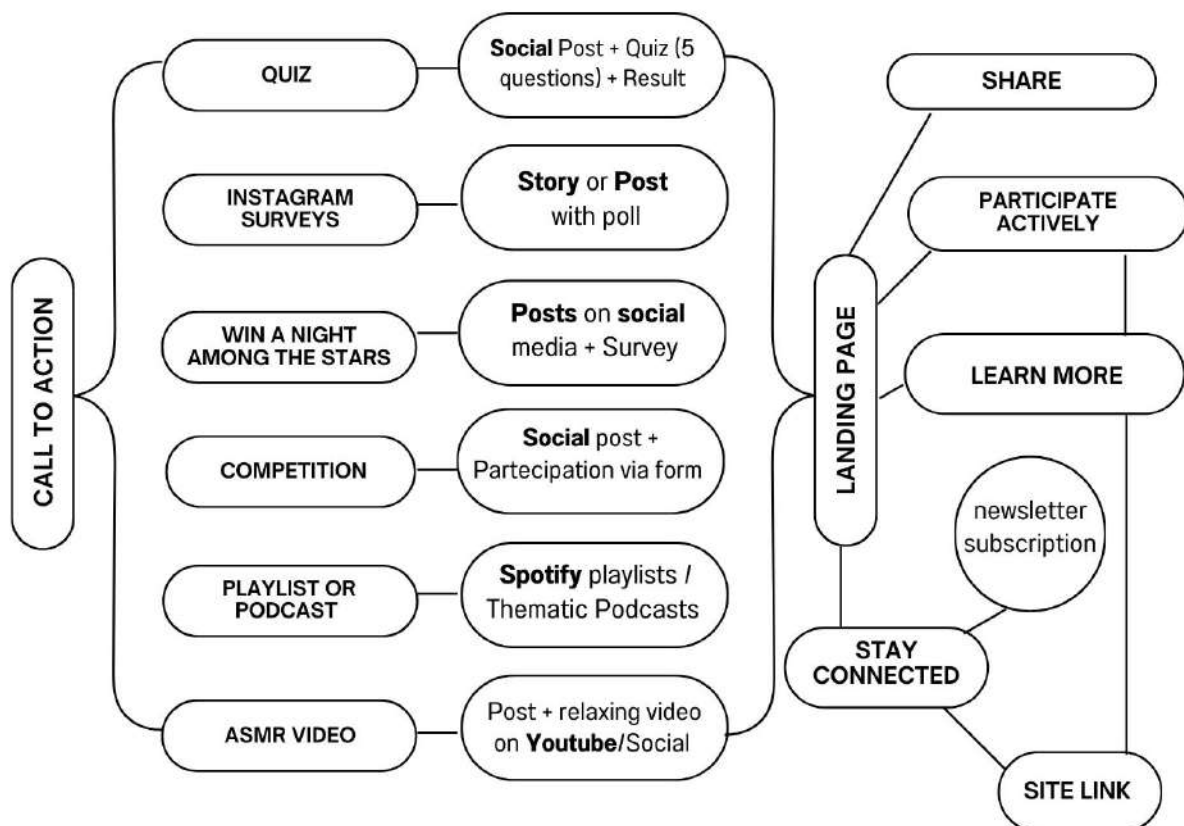


Figure 2.2.1: list of CTAs redirecting to the landing page and possible actions to be implemented in it

Once the most suitable Call To Actions have been identified, it is important to foresee



publication (and repetition) times. One could start with several CTAs and then check among the proposals used those that provided the most valuable data and repeat them halfway through the project and just before the end (three or four months).

Typical indicators for CTAs are the number of people reached, how many of them have interacted with the social content and how many have finalised the landing on the desired page. On the landing page, we can count the number of active actions (like share, download, subscription to the newsletter).

CTAs are therefore significant for our survey because the social user becomes a protagonist, being invited to "do an action" (or a series of actions) following the vision of the post/content published and therefore, in addition to an initial viewing, can show interest in wanting to deepen and respond to our quizzes/questions, put like, share etc. We could then collect specific data (depending on the questions we will insert in the quizzes or surveys), faster and in much greater numbers than with questionnaires, and furthermore, the dissemination on social networks also allows us to reach possible recipients that we had not foreseen.

2.3 Desk Research

The desk research is designed to analyse existing actions put in place by stakeholders in order to transform dark skies into an asset for sustainable local development.

Indeed, the DARKERSKY4CE partnership agreed on the valuable input that could derive from conducting a brief but clear desk research in order to monitor the activities put in place locally and to understand how active stakeholders in a given area are on the specific issue of light pollution and dark sky protection (e.g. astrotourism, nocturnal wildlife conservation, etc.).

A desk research could be very useful in mapping local interest, existing events and initiatives already underway. To organize it in a simple way you can start defining and choosing some parameters for the search.

Geographic area	It is essential to identify a specific area in order to obtain consistent data over time. If you use an administrative area it may be easier to find info. Before starting your research, make sure that the area is not too small (insufficient data) or too large (too much information, some of which may not be useful).
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Period	Again, it is important to choose specific search dates that are not concentrated in too short or too long a period. One year could be a reasonable period.
Tools	Search engines, social media, AI, specific websites (events, local observatories, international organizations)
Strategy	Use keywords/keyphrases connecting to the topic and the territory
Indicators	Number of activities, number of stakeholders involved, number of participants (if available)

2.4 Data collection, analysis and evaluation of the change

To monitor a change, as in the DARKERSKY4CE project, it is mandatory to administer surveys and/or call to actions at different moments during the monitoring time, and to reach the targeted public.

To reach the target respondents, it is possible to use different channels. Surveys can be published on local/national newspapers, together with a promotional campaign of the project and its goals. They should also be published on social media, eventually with sponsored posts, in order to target the audience and to reach potential respondents. Other possible channels are local activity groups, such as associations that deal with nature, environment, mountains, but also social issues. Call to actions will be published on the social media of the projects, of the DARKERSKY4CE partners institutions, and related ones.

For the administration time, at the beginning of the process the collected data will give a picture of the actual involvement and understanding of the light pollution threat and its implications on human life: well-being, but also social security, cultural aspects, and so on.

During the project lifetime, public events will be organized, aimed at increasing the sensitivity to the problem (communication on social networks, meeting with populations and administrators, laboratories in schools). After these actions, surveys will be administered again.

For the DARKERSKY4CE particular case, four Pilot Actions (in the following, PA) are foreseen in five Pilot Areas, covering different topics related to light pollution. The PAs will be accompanied by sensibilization events, followed by a third administration of the surveys.

In the meanwhile, CTAs will be published on social media, possibly with sponsorships.



The results of the different batches of surveys will be compared, indicators for CTAs will be monitored to see if they improve in the desired direction.

Based on the type of indicator, the statistical analysis of the collected data can foresee different techniques.

For percentages, the difference between batches can be confirmed by statistical tests, using the normal approximation of the binomial distribution when the size of the sample is sufficient. Similar tests can be used to test if a percentage is dependent on categorical variables, such as age, gender or geographical origin.

For a question where the variable is an attitude and the answer is designed as a Likert-like scale, with a set of scores (from “negative” to “positive” in usually 5 to 7 steps), it is possible to evaluate the distribution of the variable, and monitor how it changes along different batches of data.

Moreover, for the same question different answers can be proposed with simpler scales, to be able to establish an order based on respondents agreement/disagreement.

A typical example is represented in Fig. 2.1: the three answers can be ordered based on the scores of the preferences.

	Always	Often	Sometimes	Never
Waste sorting	☐	☐	☐	☐
Reducing water consumption	☐	☐	☐	☐
Reducing electricity consumption	☐	☐	☐	☐

Fig. 2.1: question with answers to be ordered based on the preferences

Advanced techniques, such as the analysis of the variance of indexes on subsamples generated by the categorical attributes, or regression analysis to link together variables in a model, can also be performed with a sufficient number of responses.

A different treatment is needed for the desk research activities, aimed mainly at obtaining an overview of the actions put in place in a given area, at a certain time, in order to increase the economic charm of dark skies.

The number and quality of initiatives can be weighted with the population covered by them and with the geographical area size. This assessment can be done at different times to assess changes in stakeholders' approaches to the issue, especially before and



after concrete actions and awareness-raising measures have been implemented. If there is a significant increase in activities, this may mean that our proposals/arguments have been “embraced” by local actors.

3. The application: DARKERSKY4CE test

3.1 From the idea to the test

The preparation of the dynamic monitoring tool involved research into existing best practices, internal discussions and consultation with experts. This led to the creation of the model of DMT presented in the previous chapters.

The following pages will explain how the DARKERSKY4CE partnership will test each tool and how the results will be evaluated. Some tests have already been carried out on small numbers.

The three surveys were developed according to the project's requirements with a series of indicators to assess changes in the perception of citizens, stakeholders and students with regard to the issue of light pollution. An initial test was carried out on a limited sample of each of the three target groups to verify the relevance and validity of the questions and answers. This made it possible to adapt three valid surveys for data collection and connected indicators. During the pilot actions that will be carried out during the project, surveys will be conducted to demonstrate their practical application on larger numbers.

This chapter also proposes possible calls to action that can be developed by partners at the local level and by the project at the transnational level. These are also useful examples that can be used by other actors to engage the various target groups.

Finally, with regard to desk research, a concrete example from the project's territory in Italy is presented, allowing readers to understand with a concrete example how the research on the activities of stakeholders on the issue of light pollution (and related ones) can be investigated in a given territory.

In practice, surveys can be considered as ready-to-use material for those who want to work on the topic of ALAN. Calls to action are proposals that are ready to use but can be adapted to the context in which people operate, while desk research is more of an indication of method, with examples, which must, however, be prepared independently.



These concrete tests, to be further developed during the project actions, will be useful for validating the dynamic monitoring tool and as a useful example for those wishing to develop a similar tool.

3.2 DARKERSKY4CE tools

3.2.1 Survey

During the project lifetime, and potentially also after its end, different batches of data will be collected.

The analysis will be performed both separately on each single State, and with data summed up together for an overall view.

The indicators from different batches will be compared, searching for statistically significant differences that will indicate if a change occurred, in the desired direction or not. They will also give an evaluation of the usefulness of the activities performed to raise awareness.

Provided that sufficient data is collected, answers can be categorized in order to gain new perspectives. For instance, one can expect different initial behaviour and different capability to absorb new attitudes based on age, gender or qualification. Furthermore, it can also be expected that people who live in a rural country, or are sensitive to sustainability, or have children to grow are already more attentive to ecological issues. However, the initial survey could not justify this assumption, underlining the need for actions to raise awareness.

For each survey, we identify a set of indicators that can be suited to give a measure of the change in the perception of the threat posed by light pollution. Not all questions are direct indicators, but can be useful to categorize data on subsamples, or to double-check key indicators, or to force the respondent to focus on the topic with practical examples, or to define future strategies.

Citizen survey

The english version of the survey dedicated to citizens can be found [here](#).

Topic	Indicator	How to analyse and measure the change
Knowledge of the “ALAN” (question #3)	P_1 = percentage of Yes	Expected a raise of P_1 , to be checked with a statistical test on proportion
In your opinion, how	Six answers (one	The “energy waste” answer



much can artificial night light affect the following areas? (question #6)	related to energy waste) to be classified as “Strong impact”, “Moderate impact”, “Little to no impact”. No “I don’t know” option. P_2 = percentage of “energy waste” marked as “Little to no impact” on the total of answers P_3 = percentage of “energy waste” marked as “Little to no impact” on the total of “Little to no impact” answers	should be marked as “Little to no impact”. P_2 and P_3 should increase. To be checked with statistical tests on proportion.
Has the level of night lighting near your home increased in the last three years? (question #7)	P_4 = percentage of “I don’t know” P_5 = percentage of “Yes”	P_4 should decrease (more people pay attention to ALAN) P_5 , categorized on geographical information, can state if ALAN is increasing or not in a certain area.
Does the light entering your bedroom at night affect the quality of your sleep? (question #9)	P_6 = percentage of “I don’t know”	P_6 should decrease (respondents pay more attention to inappropriate light). Use a statistical test on proportion. The areal location of answers is an added info.
Effects on human health of light pollution (question #10)	Five answers (one is “Vision problems (e.g. eye strain, glare, reduced night vision)”) to be classified as “Strong impact”, “Moderate impact”, “Little to no impact”. No “I don’t know” option.	In general, the classification by importance level can give a vision of how people understand light pollution and its effects on human health.
Do you feel discomfort or fear when walking through unlit places at night?	P_7 = percentage of “yes”	Even if P_7 should decrease, it is not expected due to its psychological aspect



(question #11)		
If it were possible to reduce and/or improve public lighting at night, would you be in favour? (question #12)	P_8 = percentage of “yes” P_9 = percentage of “I don’t know”	P_8 should increase P_9 should decrease Use a statistical test on proportion
Do you think that dark areas can increase the risk of crime and therefore be dangerous for human safety? (question #13)	P_{10} = percentage of “yes” P_{11} = percentage of “I don’t know”	P_{10} and P_{11} should both decrease Use a statistical test on proportion
If you have outdoor lights outside your home, how do you use them at night? (question #14)	Four answer, one is not desirable (“they are always on”) P_{12} = percentage of “always on” answer	P_{12} should decrease. To be checked with statistical tests on proportion
Have you already taken any actions to reduce light pollution in your daily life? (question #15)	P_{13} = percentage of “I don’t think is necessary” answers	P_{13} should decrease Use a statistical test on proportion
Would you support measures to reduce light pollution in your community?(question #16)	P_{14} = percentage of “No, I don’t think is a priority”	P_{14} should decrease Use a statistical test on proportion
Can you see the stars at night where you live? (question #17)	Five answers (four linked to the Bortle scale, and “I don’t know”) P_{15} = percentage of “I don’t know”	P_{15} should decrease Use a statistical test on proportion Useful to assess if awareness arises. With country categorization, can give information on the pollution of different areas.
Have you ever had the experience of observing the sky in a very dark place?	Not indicators	Useful to point the respondent attention to the following question, related to Cultural Ecosystem Services



(question #18) What topics could interest you in an astrotourism experience? (question #19)		
How important do you think it is to protect the starry sky for future generations? (question #20)	P_{16} = scale from 1 ("Not at all important") to 7 ("Very important")	The distribution of P_{16} should tend to 7 Use moments and distribution plots
Final question: "Has this survey increased your interest in light pollution?"	P_{17} = scale from 1 ("Not at all") to 5 ("Greatly")	The distribution of P_{16} should tend to the maximum. Use moments and distribution plots

A special session in the survey is dedicated to commercial operators:

How important do you consider lighting (illuminated signs, shop windows, etc.) to be for the promotion of your business?	Four answers, from "Not at all" to "Very important" P_{18} = scale from "Very important" to "Not at all important" in 4 steps	The distribution of P_{18} is an indicator of the use of artificial light for advertisement, not directly an indicator of the change.
During which time slot do you leave the advertisement lighting of your business on?	P_{19} = percentage of "Also some hours outside regular opening hours"	P_{19} should decrease To check with statistical tests on proportion
In your opinion, how positive for your business could be the development of dark sky tourism in your area (stargazing, night walks, astrophotography courses, tastings under the stars, etc.)?	Four answers, from "Negative" to "Very positive" P_{20} = scale from "Negative" to "Very positive" in 4 steps	The distribution of P_{20} should tend to "Very positive" (operators see dark skies as an additional value, related to Cultural Ecosystem Services)



A set of questions can be used to collect ancillary information, and provided that a sufficient quantity of data is collected, to target the respondents and to categorize data.

Personal information: questions about age, gender, qualification, family composition, environment in which people live, or attitude towards sustainability.		
Where did you hear about ALAN? (question #4)	Not an indicator, but useful to decide the best way to reach people with communication	
How strong are the following sources of artificial light near your home? (question #5)	Six answers (one for private, four for public lighting and "others") to be classified as "Very strong", "Moderate", "Weak or not noticeable". No "I don't know" option.	Not expected a change, useful for categorization
In your opinion, how much do the following sources contribute to light pollution? (question #8) Note: #5 is similar, but based on the personal experience of respondent	Eight answers. No "I don't know" option.	Not an indicator.
If you have outdoor lights outside your home, how do you use them at night? (question #14)	Four answers, with one "bad habit" ("They are always on")	Not an indicator subject to change easily However, it can be related to approach to sustainability



Students survey

Surveys for students are designed in a simpler way, focusing on the first-hand situations that children ranging from 6 to 12-13 years can have experienced. We foresee administering them during laboratories in schools, so in a controlled environment.

Questions range on the general knowledge of “light pollution”, its effects on humans and natural species, the personal feelings about darkness, the willingness to change. Indicators are quite similar to the previously described.

The English version of this survey can be found [here](#).

Topic	Indicator	How to analyse and measure the change
Feelings toward nature (question #1)	P_1 = Likert-like scale, from 1(not at all important) to 7 (very important)	The distribution of P_1 should increase its asymmetry toward higher values
Knowledge of the “ALAN” (question #2)	P_2 = percentage of Yes P_3 = percentage of “I don’t know”	Expected a raise of P_2 Expected a decrease of P_3 (“unaware students”) Both to be checked with a statistical test on proportion
Meaning of “light pollution” (question #4)	Four answers (one related to energy waste) with a single choice P_4 = percentage of “energy waste” P_5 = percentage of “I don’t know”	P_4 and P_5 should decrease Both to be checked with a statistical test on proportion The other two questions can give a hint on how light pollution is perceived by young people.
What are the main effects of ALAN? (question #5)	Four answers (one related to energy waste and one negative - “no effects”) with multiple choice P_6 = percentage of “increase of energy consumption” P_7 = percentage of “no effects”	P_6 and P_7 should decrease Both to be checked with a statistical test on proportion The other two questions can give a hint on how light pollution is perceived by young people.
What are the main effects of ALAN?	Six answers (one is “Air quality - more smog”)	P_6 and P_7 should increase (in this case, it indicates that



(question #8) more detailed w.r.t. #5	to be classified as “strong impact”, “moderate impact”, “little to no impact”. No “I don’t know” possibility P_8 = percentage of “Air quality” marked as “little to no impact” on the total of answers P_7 = percentage of “air quality” marked as “less important” on the total of “less important” answers	respondents are aware of the ALAN properly). Use a statistical test on proportion. In general, the classification by importance level can give a vision of how young people understand light pollution and its causes. The areal location of answers is an added info.
Effects of ALAN on wild species (fireflies - question #7 bird migration - question # 9 frogs - question #11)	Three answers (one is correct, one is a wrong effect, one is negative - “I don’t know” or “no effects”) P_8 = percentage of “correct effect” P_9 = percentage of “wrong effect” P_{10} = percentage of negative answers	P_9 and P_{10} should decrease (it indicates that respondents are not aware of the ALAN properly). P_8 should increase (its increase alone is not sufficient to distinguish on the other two indicators) To be checked with statistical tests on proportion. Answers can be summed together, or the indicators can be multiplied on each answer, to distinguish the knowledge of students of different natural phenomena.
Effects of ALAN on wild species (nocturnal animals - question #10)	Four answers, one is wrong, with multiple choice. P_{11} = percentage of wrong answers	P_{11} should decrease To be checked with statistical tests on proportion.
What can we do to reduce light pollution? (question #12)	Four answers, one correct, one wrong (reduce energy waste), two negative (“I don’t know”, “nothing to do”) P_{12} = percentage of correct answer	P_{12} and P_{13} should decrease (since they indicate that respondents are not aware of the ALAN properly). P_{12} should increase (its increase alone is not sufficient to distinguish on the other two indicators)



	P_{12} = percentage of “wrong effect” and “I don’t know” P_{13} = percentage of “nothing to do”	To be checked with statistical tests on proportion.
Where you live, can you see the stars? (question #13)	Five answers (four linked to the Bortle scale, and “I don’t know”) P_{14} = percentage of “I don’t know”	P_{14} should decrease Use a statistical test on proportion Useful to assess if awareness arises.
Are you afraid when you go through dark places? (question #16)	Four answers (“yes”, “no”, “somewhat”, “no if I’m not alone”) P_{15} = percentage of “yes”	Even if P_{15} should decrease, it is not expected due to its psychological aspect
Would you like to have an astrotourism experience? (question #17)	P_{16} = percentage of “yes”	P_{16} should increase Use a statistical test on proportion

A set of ancillary questions is foreseen:

First section on personal information Questions about school level, gender, environment in which students live		
Where did you hear about ALAN? (question #4)	Not an indicator, but useful to decide the best way to reach people with communication	
Have you ever experienced stargazing in a very dark site? (question #14)	Not an indicator	
What are the strongest	Five answers (one for	Not expected a change,



sources of artificial light near your house? (question #15)	private and four for public lighting) to be classified as “very important”, “important”, “unimportant”. No “I don’t know” possibility	useful for categorization
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Local bodies survey

Surveys for local administrators are focused on the knowledge of the current regulations, on the willingness to carry out awareness-raising actions with the population and to make an effort, also economic, to reduce light pollution.

Several questions are about the relationship between lighting and security, which is a delicate topic for a political entity such as a local administration.

The English version of the survey can be found [here](#).

Topic	Indicator	How to analyze and measure the change
When was the last upgrade (other than routine maintenance) of the street lighting system in your municipality? (question #1)	P_1 = percentage of “I don’t know”	P_1 should decrease The answers (“less than 2 years”, “between 2 and 5 years ago”, “more than 5 years ago”) can give a map of the actions already done.
Are you aware of regional (or national) regulations on public lighting and light pollution reduction? (question #2)	P_2 = percentage of Yes P_3 = percentage of “No”	Expected a raise of P_2 Expected a decrease of P_3 Both to be checked with a statistical test on proportion
What do you think are the main impacts of light pollution? (question #3)	Five answers (one related to energy waste and one negative - “not an important problem”) with up to three choices P_4 = percentage of “waste of energy and high costs”	P_4 and P_5 should decrease Both to be checked with a statistical test on proportions. The other answers can give a hint on how light pollution effects on Ecosystem Services are perceived by administrators.



	P_5 = percentage of “not an important problem”	
Has your municipality already taken specific measures to reduce light pollution? (question #4)	P_6 = percentage of “Yes” P_7 = percentage of “I don’t know” P_8 = percentage of “No”	Both P_7 and P_8 should decrease, while P_5 should increase. They are not mutually exclusive. To be checked with statistical tests on proportions.
To what extent do you consider light pollution to be a problem in your municipality? (question #5)	Four answers, ranging from “To a large extent” to “it is not a problem”. P_9 = distribution of answers	The distribution of P_9 should show an asymmetry toward “to a large extent” To be evaluated with moments, distribution plots
What type of public lighting is predominantly used in your municipality? (question #7)	P_{10} = percentage of “I don’t know” answers	P_{10} should decrease To be checked with statistical tests on proportion. The other answers give a map of the type of lighting usage.
Were devices to reduce light pollution installed in your municipality (e.g. LEDs with appropriate colour temperature, shielded lighting, night switch-off)? (question #8)	P_{11} = percentage of “No”	P_{11} should decrease To be checked with statistical tests on proportion.
What is the economic impact of public lighting on the energy costs of your municipality? (question #9)	P_{12} = percentage of “I don’t know”	P_{12} should decrease To be checked with statistical tests on proportion. The other answers give an indication of the load of lighting costs on the overall economic balance.
Has your municipality ever considered switching off or reducing public	P_{13} = percentage of “Yes”	Both P_{14} and P_{15} should decrease, while P_{13} should increase. They are not mutually



lighting during certain time slots in order to reduce consumption and light pollution? (question #10)	P_{14} = percentage of “Yes, but is not a viable solution” P_{15} = percentage of “No, there is no interest”	exclusive. To be checked with statistical tests on proportions.
What are the main difficulties in taking measures against light pollution in your municipality? (question #11)	Not an indicator of the change	It gives a hint on the perceived obstacles to a reduction of light pollution
Has your municipality ever considered astro-tourism (e.g. sky observation events, creation of areas protected from light pollution, etc.) as an opportunity for economic and tourism development? (question #16)	P_{16} = percentage of “No”	P_{16} should decrease Use a statistical test on proportion Related to Cultural aspects of Ecosystem Services.

In the following table, questions about lighting and security are described.

In your experience, do the citizens of your municipality perceive public lighting as an important safety factor? (question #6)	Three answers P_{17} = percentage of “yes, but balanced with environmental sustainability”	P_{17} should increase To be checked with statistical tests on proportion.
Has your municipality done an assessment of the balance between public safety and light pollution reduction? (question #12)	P_{18} = percentage of “Yes”	P_{18} should increase Use a statistical test on proportion While P is a direct indicator of the change, the percentage of two other answers (“No, never addressed” and “Safety is a priority on light pollution”) should be monitored to evaluate the security issue



Can light pollution be reduced without compromising citizens' perceived safety? (question #13)	P_{19} = percentage of "No, more light is equal to more security"	P_{19} should decrease
Has your municipality carried out any citizenship initiatives on street lighting? (question #14)	P_{20} = percentage of "No"	P_{20} should decrease Use a statistical test on proportion

A set of ancillary questions is foreseen:

First section on information about localization and number of inhabitants of the municipality, role of the respondent in the council		
Which tools do you consider most effective in raising public awareness of light pollution? (question #15)	Not an indicator, but useful to decide the best way to reach people with communication	
Final personal questions: age and gender of the respondent		

3.2.2 Call to action

We have identified six main types of Calls to Action that can be used for more audience engagement and data collection: quiz, polls, competitions, citizen science for a quick and fun commitment, playlists with podcasts and/or video for deeper information and insight. In this section we explain in detail the individual CTAs, giving references to the target, the social networks to be used, the steps necessary for implementation, indicators and expected results. Those who decide to use the call-to-action tool will be able to choose the ones they consider most suitable and adapt them to their own needs.



Short and Fun Quiz

NAME	DISCOVER WHAT ANIMAL OF THE NIGHT YOU ARE - (CTA1)
TYPE	Short and Fun Quiz
SOCIAL	Facebook - Instagram - (Linkedin: possible post following an article)
TARGET	Family explorer, Nature lover, Educator & prof
ACTION	🦉 What animal of the night are you? 🌙 Find out how much you know about light pollution and which nocturnal animal represents you most! 1- At night you like it: A) Being outdoors and observing the sky ★ B) Staying at home with a light on 🏠 C) Sleeping deeply 😴 2- Do you know what light pollution is? A) Of course! Too much light at night damages nature and the sky 🌍 B) More or less... it has to do with illuminated cities, right? 🤔 C) No, but I want to know more! 📖 3- Have you ever gone out somewhere very dark to see the stars? A) Yes, and I have seen incredible things! ✨ B) Sometimes, but I don't think about it often 💡 C) Never, but I'd like to try! 🚀 4- Which of these statements is true? A) Light pollution alters the rhythms of animals and plants 🦉🌿 B) Bright lights make cities safer at night 🚦 C) Darkness is always a problem and must be eliminated 🌑 ☀️ RESULTS ☀️ Majority of A → YOU ARE AN OWL! 🦉 Wise and nocturnal, you love the starry sky and know the value of darkness. Keep spreading the message! Majority of B → YOU ARE A LIGHT! ✨



	You are curious and observant, but sometimes you get distracted by artificial lights. Switch off more and observe the sky! Majority of C → YOU ARE A LIZARD! 🦎 You love the sun, but the night world is still a mystery to you. It is time to discover the beauty of the dark! 🔦 Final challenge: For one night, try turning off all the unnecessary lights you can and look at the sky. What can you see or what do you feel? Share it with us! How? You can create a video, interview or selfie and tell us what you experienced, or you can write your thoughts and inspirations in the comments, but also take a shot from where you live both outside and inside, the important thing is to use the mention and/or the hashtag: a) the material will be selected for a collective video b) win the night among the stars (see under prize proposal 2)
STRUCTURE	Social posts + Quiz (5 questions) + Result + Challenge + Landing Page
RESULT	Participation in the quiz and final challenge invitation to switch off unnecessary lights for one night and share the experience = increased awareness
INDICATORS	-number of users reached -number of users clicking on the post/video -number and % of likes -number and % of users participating in the CTA -type of answers (knowledge of the phenomenon % personal opinion about it % only possible with option c) -number and % of clicks to the final link/landing page (which may refer to a site, to a more in-depth page, to the general questionnaire or to a box for collecting addresses to be updated on dark sky events etc.) -number and % of shares with mention or hashtag
OPTIONS	A. Format Stories Create a sequence of stories with the question in the first slide and in the following stories the correct answer and a brief explanation. B. Post with Carousel (succession of slides) First slide = question, next slide = answer options, last slide = correct answer, etc.



	C. Using an External Link Create an eye-catching image for the post inviting people to take the quiz. Put a link to a quiz made with Google Forms
IN PRACTICE HISTORY OR CAROUSEL	Post inviting participation in the quiz A slide for each quiz question Slide with quiz results Slide with final challenge (optional) Slide landing page

Poll

NAME	SHORT SURVEYS (CTA2)
TYPE	Polls
SOCIAL	Instagram
TARGET	Eco-conscious, Nature lover, Local curious, Educators & Teachers
ACTION	Polls on Instagram are very attractive and used 'call to action' because they are quick and offer an immediate sense of gratification. Polls can be placed within the daily history of one's profile, require a background image or video and are essentially designed for one's followers, are quick and easy, being in stories only lasting 24 hours, but the data collected remains in the archive. It is possible in stories to ask both open questions (but often there is not much participation) and specific questions in the form of simple 'polls' with a variable number of answers, the latter usually being more popular and with them it is possible to assess interest and/or knowledge of a certain topic. Recently, the possibility was introduced to make polls in posts that remain in one's feed (which can therefore also be sponsored) and kept for a period of time that one deems suitable. Polls on Instagram are not anonymous, which means you can see who has voted and which option they have chosen. The only limitation of post polls is that they only have short answers (YES/NO). For the polls in the daily stories, on the other hand, you can choose to use some of the questions in the generic (citizens) questionnaire, or you can create some lighter and funnier ones.



STRUCTURE	Story or Post with survey + Link to Landing Page
RESULT	Quickly engaging the public and collecting data on knowledge and perceptions of darkness Deepen topic on site
INDICATORS	-number of users reached -number of users clicking on the post/video -number and % of likes -number and % of users participating in the survey -type of answers (knowledge of the phenomenon % personal opinion %) -number and % of clicks to the final link/landing page -number and % of shares with mention or hashtag -number and % of users who continue with the landing page link
IN PRACTICE POST, STORIES	Post with question Enter the 2 or 3 possible answers for the survey Slide with landing page

Competition

NAME	WIN A NIGHT AMONG THE STARS - (CTA3)
TYPE	Competition: receive a prize if you fill in our questionnaire
SOCIAL	Facebook - Instagram - (Linkedin: possible post following an article)
TARGET	Eco-conscious, Nature lover, Local curious, Educators & prof
ACTION	In most of the proposals inviting people to fill in forms and questionnaires on social media, a 'final gift' is proposed, i.e. the possibly immediate prize. The prize is the best incentive for people to take the time to answer the questions in a questionnaire. Users will then be invited with a catchy post to fill in the 'general public questionnaire', motivating them with the prospect of a prize upon completion.
STRUCTURE	Social media post + Questionnaire + Link to Landing Page
RESULT	Collecting data and encouraging questionnaire completion, collecting email addresses, offering a prize
INDICATORS	-number of users reached



	-number of users clicking on the post -number and % of likes -number and % of clicks on the link -number and % of users participating in the questionnaire -type of answers (knowledge of the phenomenon % personal opinion %) -number and % of clicks to the final link/landing page -number and % of users leaving their addresses -number and % of shares with mention or hashtag
AWARDS	All participants will receive a PDF stargazing guide (prepared by INAF). Each partner can decide on the amount and type of the prize according to its own particularities ITALY = drawing of No. X winners of free entry tickets with guided tour of local planetarium and/or observatory
IN PRACTICE POST, STORIES	Post inviting participation in the competition: "Would you like to win a night among the stars?" fill in the questionnaire! Link to google form with questionnaire (NOTE: plan to add on the questionnaire the wording related to how the prizes will be drawn specifying the obligation to enter e-mail) Link at the end of the questionnaire to the landing page

Citizen science

NAME	DISCOVER THE DARKEST SKY - (CTA4)
TYPE	Competition / Citizen Science
SOCIAL	Facebook - Instagram - (Linkedin: possible post following an article)
TARGET	Eco-conscious, Family explorer, Nature lover, Local curious, Educators & Teachers



ACTION	A competition open to all to identify and map the places in the area with the darkest skies, where light pollution is minimal. With this CTA, in addition to collecting useful scientific data on the area and other indicators related to the perception of the value of dark skies, it is an active and therefore direct way of raising awareness of the protection of the night sky. The competition is an invitation to go out and rediscover the night, people are encouraged to move away from over-lit areas and invited to observe the sky to search for the darkest places in their area. Then, in order to join the competition, one must fill in a special form (e.g. buio non ti temo) that allows one to collect useful data on location (GPS coordinates of google maps) and other information, such as measuring light with special Apps (Loss of the Night/Dark Sky Meter).
STRUCTURE	Social post + Form participation + Link to Landing Page
RESULT	Mapping the darkest skies and encouraging people to rediscover the beauty of the night, participate in the prize draw, share
INDICATORS	-number of users reached -number of users clicking on the post -number and % of likes -number and % of clicks the form link -number and % of users participating in mapping -number and % of clicks to the final link/landing page -number and % of users leaving their addresses -number and % of shares with mention or hashtag
AWARDS	One winner per prize (or several prizes to be defined with INAF as in the case of the CTA2 proposal)* will be drawn from all participants. All participants will receive a PDF stargazing guide (prepared by INAF). Each partner can decide on the amount and type of the prize according to its own particularities *ITALY = X number of free entries with a guided tour of the local planetarium and/or observatory
IN PRACTICE POST, STORIES	Post inviting participation: 'Discover the darkest sky' fill in the form!



	Link to google form (describe how prizes will be drawn, e-mail entry required) Link at the end of the form to the landing page Landing page
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Playlist/Podcast

NAME	LISTEN TO THE STARS - (CTA5)
TYPE	Playlists or Podcasts
SOCIAL	Promotion by post: Facebook - Instagram - (LinkedIn prior article)
APP	Spotify
TARGET	Playlist: Eco-conscious, Nature lover Podcast to: Eco-conscious, Nature lovers, Educators & Teachers Podcast b: Eco-conscious, Family explorer
ACTION	Creation of one or more playlists containing both Italian and international songs related to stars, dark skies and the moon. Creation of 6/10 episode podcasts dedicated to specific target groups: a) 6 episodes to "lift up your eyes and appreciate the dark skies" e.g. content: astronomy lessons, excerpts from famous books, relaxing suggestions b) 10 "in the dark you sleep better" episodes with storytelling (or parts of stories dedicated to children with topics related to dark nights and stars Organise a storytelling contest? the best stories about the preciousness of the night and dark skies will perhaps be included in a special podcast to be evaluated
STRUCTURE	Spotify Playlists / Thematic Podcasts + Link to Landing Page
RESULT	Creating an immersive experience for those who love music and storytelling, listening, sharing
INDICATORS	-number of users reached



	-number of users clicking on the post -number and % of likes -number and % of clicks to the link leading to spotify -number of tracks entered by users (playlists only) -number and % of clicks to the final link/landing page -number and % of users following the audio channel -number and % of shares
IN PRACTICE POST, STORIES (promotion) AUDIO CONTENT	Post with links to promote audio content on Spotify: PLAYLIST: Create a music playlist containing both Italian (or your own country's) and international songs related to stars, dark skies and the moon. Invitation to collaborate in the creation of playlists (i.e. those who receive the link can add tracks to enrich it). Invitation to share, download, follow PODCAST: a) make 6 episodes to "lift up your eyes and appreciate the dark skies". b) making 10 'in the dark you sleep better' episodes Invitation to share, download or follow

Video

NAME	IS THE DARK SCARY OR GOOD? - (CTA6)
TYPE	ASMR Video
SOCIAL	Promotion by post: Facebook - Instagram - (Linkedin previo articolo)
APP	YouTube
TARGET	Eco-conscious, Nature lover,



ACTION	Create and share on our main channels a video with ASMR (Autonomous Sensory Meridian Response) features, i.e. a relaxing video of dark, starry skies with sounds from space or a soundtrack and/or slow voice telling why darkness is precious to humans. The ASMR technique, coined in 2010, refers to a relaxing, often sedative sensation that starts on the scalp and spreads to the rest of the body. These videos are widely used to relax and especially to help people sleep. Example ASMR: https://www.youtube.com/watch?v=eimBu-yuWis https://www.youtube.com/watch?v=B5unCXpegAw https://www.instagram.com/reel/C-B-7cDuNGy/?igsh=MXQ5dHpzaWZneHV3bA==
STRUCTURE	Post + relaxing video on Youtube/Social + Link to Landing Page
RESULT	Showing the value of dark skies through relaxing images and sounds and sharing the video
INDICATORS	-number of users reached -number of users clicking on the post -number and % of likes -number and % of clicks to the link leading to youtube -number and % of clicks to the final link/landing page -number and % of users following the channel -number and % of shares
IN PRACTICE POST, STORIES (promotion)	Posts with links to promote audio and video content on YouTube Creating a video with ASMR features
AUDIO VIDEO CONTENT	Sharing the post and videos in our main channels

3.2.3 Desk Research

As regards desk research, given the nature of the research, the project has already been able to carry out a small study in Italy, allowing a concrete example to be included in this document.

In the first example it was privileged the research on the types of events proposed in the territory, in the second our research was focused on counting the events dedicated to



the public related to the observation of the night sky.

Example n° 1

Search parameters

area	period	words/phrases/key	Tools/channels
Turin and Piedmont	01/01/2024 30/04/2025	astronomy events/ walks in the dark skies	Google/FB

What we found?

Title	ALAN	Exploitation of dark skies	Type	Link
new lighting	x		article	https://www.lastampa.it/torino/2025/04/07/news/nuova_illuminazione_strade_buie_passerella_olimpica-15091634/
Heritage to be preserved		x	project	https://www.interreg-alcotra.eu/it/exo-eco-esopianeti-ecologia-il-cielo-e-le-stelle-delle-alpi-patrimonio-immateriale-delleuropa
Energy saving	x		article	https://www.piazzapinerolese.it/2025/02/08/mobile/leggi-notizia/argomenti/attualita-18/articolo/la-luce-costera-meno-anche-sotto-i-portici-di-luserna-san-giovanni.html?sfnsn=scwspwa
observing stars		x	event	https://planetarioditorino.it/sotto-un-cielo-di-stelle
street lighting	x		project	https://webthesis.biblio.polito.it/3385/
Criticism of the event	x		article	https://www.valsusaoggi.it/lettera-le-critiche-al-fascio-di-luce-della-sacra-di-san-michele/
Reflections ALAN	x	x	conference	https://www.esero.it/evento/sotto-un-cielo-di-stelle-riflessioni-sull'inquinamento luminoso-millumino-di-meno-xxi-edizione-



				16-02-2025/
Astronomy and art		x	event	https://fondoambiente.it/eventi/astronomi-per-una-notte-al-castello-della-manta
Space festival		x	event (4 days)	https://www.compagniadisanpaolo.it/it/news/torino-space-festival-2024/
Astronomical events		x	article	https://www.torinotoday.it/social/eventi-astronomici-agosto-2024-superluna-storione-stelle-cadenti-san-lorenzo.html

Example n°2

Search parameters

area	period	words/phrases/key	Tools/channels
Turin and Piedmont	01/01/2024 31/12/2024	"2024 events and evenings astronomy Piedmont"	Google search

What we found?

type of event	n°	link
Evenings FAI	6	https://langhe.net/evento/sere-fai-destate-14-08-2024/
Evening of observation	1	https://www.diocesi.torino.it/site/wd-appointamenti/dal-parco-alla-luna-e-oltre-festival-g-astronomico-ed-2024/
Abbonamento Musei in collaboration with Infinito - Evening of observation	4	https://abbonamentomusei.it/evento/serate-osservative/
Tasting evenings and observation with telescope	7	https://www.astronomitaly.com/blog/astronomitaly-in-tour-eventi-esperienze-osservazioni-astronomiche-telescopio-italia-pianeti-stelle-cadenti-nebulose-stargazing



Night walks	19	https://www.ecomuseodellerocche.it/it/news/12/notturmi-nelle-rocche-2024
night of “San Lorenzo”	1	https://www.mentelocale.it/torino/56443-la-notte-di-san-lorenzo-alla-precettoria-di-sant-antonio-di-ranverso.htm
Observation, study and tasting evenings	11	https://www.osservatorioalpette.it/eventi/2024/
Astronomy day	1	https://planetarioditorino.it/astronomy-day-2024
Evening observation	5	https://liceocuneo.it/evento/osservatorio-astronomico-planetario/
Summer camp “ass. astrofili”	1	https://www.gawh.it/main/events/campo-estivo-2024/
TOTAL	56	

This small study allowed us to analyse an area of 25,387.07 km² with just over 4 million inhabitants and average tourist appeal (medium-high for the Turin area) over a period of 16 months (Eurostat, 2022⁴).

The analysis led to the identification of 56 events of various types (not exhaustive), with an average of 3.5 events per month. This calculation does not take into account the activities organised by the 17 amateur astronomy associations (which organise an average of about 4 events per year per association) and 7 public observatories and the Turin Astronomical Observatory.

This analysis allows us to make an initial screening of the actors active in the region and to understand that the issue is still little discussed, both in press articles and in organised events, which are mainly managed at a scientific level or by associations. On the other hand, there are no significant figures in terms of the development of astro-tourism, for example.

Articles and events on light pollution are also practically non-existent.

This practical example therefore provides an initial overview of the situation in a given area, possible collaborations and gaps. If necessary, the same study can be carried out after a year to check whether the actions taken on a given issue, such as light pollution, have led to an increase in activities on that issue.

⁴https://ec.europa.eu/eurostat/databrowser/view/tour_occ_nin3/default/map?lang=en



4. References

This project relies on relationships with citizens. Communication is a fundamental task of this work, and it has been designed in the framework of the AMEC (the international Association for Measurement and Evaluation of Communication) principles. The usage of the AMEC IEF (Integrated Evaluation Framework) has helped to identify the communication objectives from the organizational ones, derived from the Application Form, to select targets and strategic inputs.

The IEF will also be used to collect outputs during the project lifetime.

The current status of the implementation is summarized in the appendix A.



Appendix A

AMEC Measurement Framework DARKERSKY4CE

PREPARATION	ALIGN OBJECTIVES	
	ORGANISATIONAL OBJECTIVES	COMMUNICATION OBJECTIVES
	We want to measure: - the change in the perception of the threat posed by light pollution - the change in the assessment of the ecosystem value of dark skies - the actions put in place by stakeholders to transform dark skies into an asset for sustainable local development.	- Raise awareness of the light pollution threat - Enlarge the community of aware people - Improve relationship between common people and stakeholder - Improve relationship between civil community and administration
	INFORM & PREPARE COMMUNICATION	
	TARGET AUDIENCE	STRATEGIC INPUTS
	1 General public 2 Students 3 Administration 4 Private association with interest in light pollution issue 5 Economic operators (?)	Tools: - Surveys - Call to actions - Pilot actions
IMPLEMENTATION	IMPLEMENT	
	ACTIVITIES	
	○ Surveys to citizen ○ Surveys to students ○ Surveys to local administrations ○ Call to actions: quiz (instagram, facebook) ○ Call to actions: stories (instagram) ○ Call to actions: video or podcast ○ Events to population on Pilot Action ○ Laboratories for students	



MEASUREMENT & INSIGHTS	MEASURE ACTIVITY	
	OUTPUTS	
	○ Project site: news (general public) ○ Project social sites: LinkedIn, Facebook, Instagram (general public) ○ Citizen survey: to be administered	○ Students survey: tested on primary/secondary school (Italy) ○ Administrator survey: tested on two administrations (Italy)
	AUDIENCE RESPONSE & EFFECTS	
	OUT-TAKES	OUTCOMES
	ORGANISATION & STAKEHOLDER EFFECTS	
	ORGANIZATIONAL IMPACT	



Appendix B

Citizens survey

Actively participate in the preliminary investigation of the Interreg Central Europe project DARKERSKY4CE.

By filling in this questionnaire, you can help us understand how the night is, how it is perceived and lived: dark skies or bright nights?

The questionnaire is anonymous.

The time required to complete the questionnaire is approximately 10 minutes.

The DARKERSKY4CE partnership thanks you in advance for your time and valuable contribution.

1. Age

2. Gender

☐ F ☐ M ☐ Other

3. Education level

- ☐ Primary education
- ☐ Secondary education
- ☐ High school diploma
- ☐ University degree

4. Family composition

- ☐ Single
- ☐ Cohabiting
- ☐ With children
- ☐ With parents

5. Where do you live?

- ☐ In a big city



- ☐ In a small town or in the suburbs
- ☐ In a village
- ☐ In an isolated area

6. Where is the place where you live located?

- ☐ On a plain
- ☐ On a hill
- ☐ In a piedmont area
- ☐ In the mountains
- ☐ Other

7. Postcode

8. Country

Austria - Croatia - Czech Republic - Germany - Hungary - Italy - Poland - Slovakia - Slovenia - Other
European country - Other

9. Current employment

- ☐ Primary or secondary school student
- ☐ University student
- ☐ Worker in the primary sector (agriculture, animal husbandry, etc.)
- ☐ Worker in the secondary sector (manufacturing, construction industry, handicraft, agri-food, etc.)
- ☐ Worker in the tertiary sector (commerce, transport, administration, healthcare, research, etc.)
- ☐ Pensioner
- ☐ Other

10. Do you run a business? (hotel, B&B, pub, shop, etc.)

- ☐ Yes Skip to question 11



☐ No Skip to question 14

Economic Operators

11. How important do you consider lighting (illuminated signs, shop windows, etc.) to be for the promotion of your business?

- ☐ Very important
- ☐ Of average importance
- ☐ Of little importance
- ☐ Not relevant (I do not have illuminated signs or shop windows)

12. During which time slot do you leave the advertisement lighting of your business on?

- ☐ Always
- ☐ Only during opening hours
- ☐ Also some hours outside regular opening hours

13. In your opinion, how positive for your business could be the development of dark sky tourism in your area (stargazing, night walks, astrophotography courses, tastings under the stars, etc.)?

- ☐ Very positive
- ☐ Positive
- ☐ Irrelevant
- ☐ Negative

Section A : General Information

14. How important do you consider environmental protection to be in your daily life?

1	2	3	4	5	6	7
Not important				Very important		



15. How often do you perform the following actions?

	Always	Often	Sometimes	Never
Waste sorting	0	0	0	0
Reducing water consumption	0	0	0	0
Reducing electricity consumption	0	0	0	0
Using electricity at specific times of the day	0	0	0	0
Using more sustainable means of transport	0	0	0	0

16. Do you know what "light pollution" is?

Yes

No

17. If yes, where did you hear about it?

- ☐ Social media or Internet
- ☐ Radio or TV
- ☐ Magazines or publications
- ☐ Friends or acquaintances
- ☐ Associations
- ☐ Work
- ☐ Other

18. How strong are the following sources of artificial light near your home?

	Very strong	Moderate	Weak or not noticeable
Your own outdoor lighting	0	0	0



Your neighbors' outdoor lighting	0	0	0
Commercial lighting (e.g. shops, businesses)	0	0	0
Streetlights and residential area lighting	0	0	0
Car lights and passing traffic	0	0	0
Other light sources	0	0	0

Section B : Knowledge and Effects of Light Pollution

19. In your opinion, how much can artificial night light affect the following areas?

	Strong impact	Moderate impact	Little to no impact
Biodiversity loss (e.g. decline in pollinating insect populations)	0	0	0
Disorientation of wildlife	0	0	0
Human health	0	0	0
Energy consumption and waste (due to unnecessary lightning)	0	0	0
Cultural heritage and nightscapes (visibility of historical sites, starry skies)	0	0	0
Public safety (impact on visibility, glare-related risks)	0	0	0
Astronomical	0	0	0

20. Has the level of night lighting near your home increased in the last three years?

☐ Yes

☐ No

☐ I don't know

21. In your opinion, how much do the following sources contribute to light pollution?



	Very significant contribution	Moderate contribution	Little or no contribution
Public and street lighting	0	0	0
Transportation systems (e.g. airports, railway stations)	0	0	0
Industry and agriculture (including animal husbandry)	0	0	0
Shopping centres, parking lots, and commercial lighting	0	0	0
Sports facilities and floodlights	0	0	0
Lightning of buildings, public monuments and landmarks	0	0	0
Private residential	0	0	0
Temporary events (e.g. festivals, work lights, construction sites)	0	0	0

22. Does the light entering your bedroom at night affect the quality of your sleep?

- ☐ Yes
- ☐ No
- ☐ I don't know
- ☐ No light enters

23. In your opinion, what are the main negative effects of light pollution on human health?

	Strong impact	Moderate impact	Little to no impact
Sleep disorders (difficulty or poor quality of sleep, reduced productivity and cognitive function)	0	0	0
Increased stress and anxiety (mood disturbances, depression, risk of chronic diseases)	0	0	0



Disruption of melatonin production (weakening of the immune system)	0	0	0
Vision problems (e.g. eye strain, glare, reduced night vision)	0	0	0
Disruption of circadian rhythms (affecting sleep-wake cycles and overall health)	0	0	0

Section C : Behaviours and Solutions

24. Do you feel discomfort or fear when walking through unlit places at night?

- ☐ Yes
- ☐ Somewhat
- ☐ No
- ☐ I don't know

25. If it were possible to reduce and/or improve public lighting at night, would you be in favour?

- ☐ Yes
- ☐ I don't know

26. Do you think that dark areas can increase the risk of crime and therefore be dangerous for human safety?

- ☐ Yes
- ☐ No
- ☐ I don't know

27. If you have outdoor lights outside your home, how do you use them at night?

- ☐ They are always on
- ☐ I switch them on when necessary
- ☐ I use timers or motion sensors



☐ I have no outdoor lights

28. Have you already taken any actions to reduce light pollution in your daily life?

☐ Yes, by using energy-efficient lighting

☐ Yes, by reducing outdoor lighting at night

☐ No, but I would like to learn more

☐ No, I don't think it's necessary

29. Would you support measures to reduce light pollution in your community?

☐ Yes, definitely

☐ Maybe, depending on the measures

☐ No, I don't think it's a priority

Section D : Perception and Self-Reflection

30. Can you see the stars at night where you live?

☐ I can clearly see the Milky Way

☐ I cannot see the Milky Way, but I can see many stars

☐ The night sky is grey, but I can see some stars

☐ The sky is grey-orange

☐ I don't know

31. Have you ever had the experience of observing the sky in a very dark place?

☐ Yes, it was very exciting

☐ Yes, it was nice

☐ Yes, but I didn't feel comfortable

☐ No



32. If you had the chance to participate in an astrotourism experience or night walk, what topics would you be most interested in learning about?

	Strong interest	Moderate interest	Little to no interest
Astronomy and constellations	0	0	0
Night nature and nocturnal ecosystems (e.g. behaviour of animals and plant life at night)	0	0	0
The impacts of light pollution on ecology, wildlife, and human health	0	0	0
The role of dark skies in cultural heritage and mythology	0	0	0

33. How important do you think it is to protect the starry sky for future generations?

1 2 3 4 5 6 7

Not important Very important

34. Is this your first time taking our survey?

☐ Yes

☐ No, I had already taken this survey

35. Has this survey increased your interest in light pollution?

1 2 3 4 5



School Survey

Participate as a protagonist in the research of the Interreg Central Europe project DARKERSKY4CE.

By filling in the questionnaire you can help us collect valuable information.

What do you think of the night: better to have dark skies or bright nights?

The questionnaire is **anonymous**.

The time required to complete the questionnaire is approximately **5 minutes**.

Age

Gender

☐ F ☐ M ☐ Other

You are a student in...

- ☐ primary school
- ☐ middle school
- ☐ high school

Name of your school or institute

Where do you live?

- ☐ In a big city
- ☐ In a small town or in the suburbs
- ☐ In a village
- ☐ In an isolated area

Where is the place where you live located?

- ☐ On a plain
- ☐ On a hill
- ☐ In a piedmont area
- ☐ In the mountains
- ☐ Other

Country

Austria - Croatia - Czech Republic - Germany - Hungary - Italy - Poland - Slovakia - Slovenia - Other European country - Other



What is the name of your municipality?

Postcode

Section A : General Information and Knowledge about the Effects of Light Pollution

In your opinion, is it important not to harm nature?

1 2 3 4 5 6 7

Not at all important Very important

2-Have you ever heard of "light pollution"?

- ☐ Yes
- ☐ No
- ☐ I don't know

3-If yes, where did you hear about it?

- ☐ Social media or Internet
- ☐ Radio or TV
- ☐ Magazines or publications
- ☐ Parents, friends or acquaintances
- ☐ School
- ☐ Other

4-What do you think "light pollution" means?

- ☐ Too many artificial lights at night that make it difficult to see the dark sky
- ☐ Lights that consume too much energy
- ☐ The lighting of streets and houses at night
- ☐ I don't know

5-What effects can light pollution have?

(You can select more than one option)

- ☐ It makes it difficult to see the stars
- ☐ It disturbs the sleep of people and animals
- ☐ It increases energy consumption



☐ It has no negative effects

6-Have you ever seen a firefly? Where?

☐ Garden

☐ Countryside

☐ City

☐ I have never seen a firefly

7-Fireflies use light signals to communicate. In your opinion, can too much artificial light disturb fireflies?

☐ Yes

☐ No

☐ I don't know

8-In your opinion, how much can artificial night light affect the following areas?

	Strong	Moderat	Little to no impact
Reduction of animal and plant species	☐	☐	☐
Air quality (more smog)	☐	☐	☐
Reduction of pollinating insects (bees, butterflies, etc.)	☐	☐	☐
Orientation problems for migratory birds	☐	☐	☐
Disorientation of wild species	☐	☐	☐
Astronomical research	☐	☐	☐

9-Some birds migrate at night following the stars. What would happen if they could no longer see them?

☐ They would get lost

☐ They would fly faster

☐ Nothing would change

10-Light pollution can affect the behaviour of nocturnal animals. Which of these animals could have problems?

☐ Bats

☐ Owls

☐ Hedgehogs

☐ Squirrels



11-Some amphibians, such as frogs, stop singing when there is too much light. What would happen if they stopped singing?

- ☐ They would not be able to find a partner
- ☐ They would be faster
- ☐ Nothing would change

12-In your opinion, what could be done to reduce light pollution?

- ☐ Switch off unnecessary lights
- ☐ Use more efficient lamps
- ☐ Nothing can be done
- ☐ I don't know

Section B : Perception and Self-Reflection

13-Can you see the stars at night where you live?

- ☐ I can clearly see the Milky Way
- ☐ I cannot see the Milky Way, but I can see many stars
- ☐ The night sky is grey, but I can see some stars
- ☐ The sky is grey-orange
- ☐ I don't know

14-Have you ever had the experience of observing the sky in a very dark place?

- ☐ Yes, it was very exciting
- ☐ Yes, it was nice
- ☐ Yes, but I didn't feel comfortable
- ☐ No

15-What are the strongest and most important lights near your home?

	Very important	Important	Unimportant
The outdoor lights of your home	0	0	0
The outdoor lights of your neighbours' house	0	0	0
The lights of shops	0	0	0
Street lights and lights of residential areas	0	0	0
Car lights and passing traffic	0	0	0



16-Are you afraid of walking through unlit places at night?

- ☐ Yes
- ☐ Somewhat
- ☐ No
- ☐ Not if I have company

17-Would you like to live an "astrotourism" experience, a holiday to discover the dark skies and stargaze?

- ☐ Yes
- ☐ No
- ☐ I don't know

18-In your opinion, how could we protect animals from light pollution?

19-Is this your first time taking our survey?

- ☐ Yes
- ☐ No, I had already taken this survey

Local bodies

Dear Mayor / Municipal Administrator / Municipal Employee,

This questionnaire is part of a preliminary investigation of the Interreg Central Europe project DARKERSKY4CE and aims to collect information on current public lighting policies and light pollution awareness, i.e. excessive artificial lighting, within your municipality.

Your contribution as a public authority is essential to develop more sustainable strategies.

The time required to complete the questionnaire is approximately **7 minutes**.

The DARKERSKY4CE partnership thanks you in advance for your time and valuable contribution.

Municipality of work

Postcode

How many inhabitants does the municipality where you work have?

- ☐ Less than 5,000
- ☐ Between 5,000 and 20,000



- ☐ Between 20,000 and 50,000
- ☐ More than 50,000

What position do you hold within your municipality?

- ☐ Mayor
- ☐ Councilmember
- ☐ Technical Office Manager
- ☐ Other _____

Section A : Awareness and Perception

1-When was the last upgrade (other than routine maintenance) of the street lighting system in your municipality?

- ☐ Less than 2 years ago
- ☐ Between 2 and 5 years ago
- ☐ More than 5 years ago
- ☐ I don't know

2-Are you aware of regional (or national) regulations on public lighting and light pollution reduction?

- ☐ Yes, in detail
- ☐ Yes, but only in general
- ☐ No

3-What do you think are the main impacts of light pollution?

(You can select up to 3 options)

- ☐ Waste of energy and high costs
- ☐ Impact on human health (sleep disorders, etc.)
- ☐ Alteration of ecosystems and the nocturnal fauna
- ☐ Difficulties in astronomical observation and astrotourism
- ☐ I do not consider it to be an important problem

4-Has your municipality already taken specific measures to reduce light pollution?

- ☐ Yes
- ☐ No
- ☐ I don't know



5-To what extent do you consider light pollution to be a problem in your municipality?

- ☐ To a large extent
- ☐ To a moderate extent
- ☐ To a minimum extent
- ☐ It is not a problem

6-In your experience, do the citizens of your municipality perceive public lighting as an important safety factor?

- ☐ Yes, they consider it essential for urban safety
- ☐ Yes, but to be balanced with environmental sustainability
- ☐ No, it is not a particularly heartfelt topic

Section B : Public Lighting and Management

7-What type of public lighting is predominantly used in your municipality?

- ☐ Traditional lighting
- ☐ Cold light LEDs
- ☐ Warm light LEDs
- ☐ Other types of lighting
- ☐ I don't know

8-Were devices to reduce light pollution installed in your municipality (e.g. LEDs with appropriate colour temperature, shielded lighting, night switch-off)?

- ☐ Yes, in all areas
- ☐ Yes, but only in certain areas
- ☐ No, but it is planned
- ☐ No

9-What is the economic impact of public lighting on the energy costs of your municipality?

- ☐ Less than 15%
- ☐ Between 15% and 25%
- ☐ More than 25%
- ☐ I don't know

10-Has your municipality ever considered switching off or reducing public lighting during certain time slots in order to reduce consumption and light pollution?

- ☐ Yes, it has already been implemented or planned
- ☐ Yes, but it is not a viable solution



- ☐ No, but it would be interesting to consider
- ☐ No, there is no interest

11-What are the main difficulties in taking measures against light pollution in your municipality?

(You can select up to 3 options)

- ☐ High costs of lighting modifications
- ☐ It is not a priority
- ☐ Resistance from citizens and/or businesses
- ☐ Lack of clear regulations
- ☐ Lack of competent personnel
- ☐ Other

12-Has your municipality done an assessment of the balance between public safety and light pollution reduction?

- ☐ Yes, criteria were adopted to ensure safety and sustainability
- ☐ Yes, but no concrete solutions have been implemented yet
- ☐ Yes, safety takes priority over reducing light pollution
- ☐ No, we have never addressed the issue in these terms

Section C : Future Initiatives and Involvement

13-Can light pollution be reduced without compromising citizens' perceived safety?

- ☐ Yes, with adequate lighting (e.g. timers, directional lights and motion sensors)
- ☐ Yes, but a cultural change in the perception of safety is needed
- ☐ No, more light equals more safety

14-Has your municipality carried out any citizenship initiatives on street lighting?

- ☐ Yes, on light pollution
- ☐ Yes, on the issue of safety
- ☐ Yes, on both
- ☐ No

15-Which tools do you consider most effective in raising public awareness of light pollution?

(You can select up to 3 options)

- ☐ Online and social media information campaigns
- ☐ Public events and sky observation evenings
- ☐ Economic incentives for adopting sustainable lighting



- ☐ Involvement of schools and educational projects
- ☐ Disincentivizing activities (e.g. sanctions)

16-Has your municipality ever considered astrotourism (e.g. sky observation events, creation of areas protected from light pollution, etc.) as an opportunity for economic and tourism development?

- ☐ Yes, we have already implemented some initiatives
- ☐ Yes, but no concrete activities have been implemented yet
- ☐ No, but it could be an interesting opportunity for the territory
- ☐ No, we do not think it can have a significant impact on the community

17-Do you have any suggestions or comments on how to improve public lighting management in order to reduce light pollution in your municipality?

Age

Gender

- ☐ F ☐ M ☐ Other