Conférence Européenne
des Directeurs des Routes

Conference of European
Directors of Roads

CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME

Call 2024

Road Lighting – The Light we Need

CEDR Transnational Road Research Programme

funded by

(countries to be confirmed)

Description of Research Needs (DoRN)

DRAFT

Draft DoRN has no details of the potential budget or the funding countries, but it has all the necessary technical details.

Publishing DoRN does not constitute a commitment by CEDR or any of its members to launch the corresponding research call.

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1 General Introduction

This Description of Research Needs (DoRN) relates to a Call for Proposals entitled **CEDR Transnational Road Research Programme Call 2024** launched by the Conference of European Directors of Roads (CEDR). CEDR is an organisation which brings together the directors of 29 European road authorities. CEDR provides a platform for cooperation and promotion of improvements to the road system and its infrastructure, as an integral part of a sustainable transport system in Europe. The website ***www.cedr.eu*** contains a full description of its structure and activities.

CEDR recognises the importance of research in the development of sustainable transport and has established Working Groups (WGs) aimed at the analysis of relevant and specific topics of interest from an NRA perspective. Through CEDR Working Groups, CEDR members work together to identify needs for research collaboration and manage research activities.

The Governing Board of CEDR (CEDR GB) has given a mandate to relevant WGs to identify opportunities for transnational road research programmes on an annual basis. CEDR GB also requested that:

- WGs only propose suitable research topics and identifies good research proposals;
- WGs present research proposals, when appropriate, to CEDR GB for decision; CEDR GB will decide what programmes are taken forward;
- All call procedures shall be open and transparent and organisation from all European countries shall be invited to participate, with no advantages given to preferred suppliers or groups of suppliers; and
- The costs of developing and managing the transnational calls shall be supported only by those CEDR members and their partners taking part in the programme.

2 Introduction to Call 2024

The CEDR Transnational Research Road Programme is supported by CEDR to fulfil the common interests of the National Road Authority (NRA) members of CEDR. The participating NRAs in this Call are (to be determined). As in previous collaborative research programmes, the participating members will establish a Programme Executive Board (PEB) made up of experts in the topics to be covered: the PEB will act as a steering committee for the programme. The research budget will be jointly provided by the participating NRAs: the participating NRAs will also nominate the individual member of the PEB. The PEB has designated (to be determined) to act as PEB chair.

CEDR GB has, appointed the CEDR Secretariat to assume the role of Programme Manager (ProgMan) to take over the administration of this Call for Proposals. For this Call, the ProgMan will be Naida Muirhead. The responsibilities of the ProgMan include preparation of the Call for Proposals, financial management of the programme and setting up and managing the contracts with the research providers. These responsibilities will be conducted by the ProgMan in its country under its law and regulations. The terms under which the ProgMan and PEB will operate will be set out in a Collaboration Agreement, signed by senior representatives of each participating NRA.

Applications are invited from suitable qualified contractors in response to this Call for Proposals. In the case of groupings, there are no geographic restrictions on consortia partners provided that any project consortium is led by a legal entity established in a European country.

Individuals and organisations involved in the development or approval of the Call or its management are prohibited from any involvement in proposals. Applications should focus on the sharing of national research, knowledge and experience at all levels as an important prerequisite for achieving the goals of CEDR and its members. This will accelerate the development of faster and durable methods and techniques for road maintenance and management. It is particularly important that the results be easily implementable by road authorities across Europe, and applicants are encouraged to include case studies and demonstration projects in submissions so as to contextualise the research and illustrate the benefits of transnational collaboration.

In addition to cooperation with the PEB, selected projects are also expected to work with relevant CEDR Working Groups, activities and other bodies (such as the Executive Board) and include them in the projects' activities (e.g. workshops, etc.). For this call, particular attention may be given, individually or collectively, to WG Environment and WG Road Safety.

Applications will be evaluated by the PEB in relation to:

- Extent to which the proposal meets the requirement of the DoRN
- Track record of consortium members
- Management of project
- Value for money.

Details of these evaluation criteria and how they will be interpreted and applied by the PEB are presented in the Guide for Applicants (GfA) which accompanies this Call for Proposals.

3 Aim of the Call

Road lighting has a significant influence on our society but there is currently a lack of evidence on its impacts (both positive and negative) on the environment, road safety and energy consumption/light emissions. The aim of this call "Road Lighting - The Light We Need" is to produce practical guidance on the implementation of sustainable road lighting across Europe's roads with a view to reducing illumination impacts on nature, mitigating skyglow, improving road safety and reducing energy consumption. This project will require a holistic approach to address a challenge that all European countries are facing in the midst of the current energy crisis.

4 Reasons for this Transnational Road Research Programme

Light pollution is an environmental issue that has received much attention in recent years due to its negative impact on flora and fauna.[1] According to the International Commission on Illumination (CIE) light pollution is defined as the total sum of all adverse effects of artificial light.[2] The introduction of LED lights has significantly increased the impacts of light pollution across Europe which has resulted in 60% of Europeans being unable to witness the Milky Way

[1] European Commission, Directorate-General for Environment, Light pollution – Mitigation measures for environmental protection, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2779/906521

[2] CIE, International Lighting Vocabulary, 2020

from their homes. Current research indicates that the brightness of the sky is increasing by approximately 10% on an annual basis.[3]

There is a strong scientific consensus that light pollution, from road lighting and other sources, leads to a variety of impacts on flora and fauna alike leading to disruptions in circadian rhythms, altered phenology, changes in population dynamics, movement/migration and other changes. However, it is uncertain how these changes impact wider ecosystem services as there is a current gap in science due to the extensive studies required to yield definitive proof.[4]

Light pollution is considered to be a waste of energy. The energy crisis in Europe has made energy savings from street lights a topic of high interest among many European road administrations.[5]

Illumination of roads is an important tool to increase road safety, especially at junctions and in urban areas. However, over the past decade, the environmental implications are becoming more apparent due to an overuse of lighting on major infrastructure. We now appear to have more light than we need.

All European countries have a significant number of streetlights, notably found in urban areas. However, in rural areas illumination varies greatly between countries; from 2% in Iceland, 5% in Italy, 30% in Norway, to 50% in the Netherlands. There are also differences when deciding whether or not a road should be illuminated taking into account traffic volumes, road safety assessments prior to illumination, and lighting zones which take into account whether lighting is needed in order to keep natural areas dark.[6]

The introduction of LED lights makes the topic of light pollution even more relevant. LED lights are energy efficient and customisable, including angle of lighting, motion detection integration and adjusting colour temperature. Whilst LED lights are a part of the light pollution issue, they are an obvious part of the solution to reduce light pollution from roads. In many cases LED lights have more light in the blue spectrum compared to HPS, which is negative for sky glow. Due to the low energy consumption, ease of installation and control management of LED technology, we see an increase of number of lighting points as well.

In *The Light We Need* European national road administrations unite in a common research project addressing a great challenge along a large part of European road networks: lights everywhere, in the midst of the nature crisis, in the midst of the European energy crisis, in the midst of the LED light revolution. The aim of this research program is to reduce light pollution from road lighting across European roads. To do this, it is important to find *relevant* solutions that are *sustainable*, meaning that the environmental considerations described above are balanced together with *economic* and *social* considerations. Interdisciplinary approaches have to be envisaged.

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[3] Fabio Falchi et al., The new world atlas of artificial night sky brightness. Sci. Adv.2,e1600377(2016). https://doi.org/10.1126/sciadv.1600377

[4] Hirt Myriam R., Evans Darren M., Miller Colleen R. and Ryser Remo 2023Light pollution in complex ecological systemsPhil. Trans. R. Soc. B37820220351. https://doi.org/10.1098/rstb.2022.0351

[5] https://www.cedr.eu/docs/view/6615626373b39-en

[6] https://www.cedr.eu/docs/view/661561e62a004-en

Economic

Road lighting is a big investment as lighting fixtures, light poles and electrical infrastructure requires a lot of capital to set up and maintain. Additionally, road lighting has a significant energy demand. From an LCC perspective, the biggest impact is energy consumption.

Depending on the type of light and the strategies of reducing light pollution, the cost of a road lighting system can vary with factors including frequency of light poles, the type of light fixtures, and other technological considerations such as motion detection, remote control and adaptive systems. There are also different and less expensive ways of increasing visibility on roads without the use of road lighting, for example the use of reflectors, anti-glare systems, road markings, speed limits and the nature of the road. On the other hand, under certain conditions, road lighting may reduce the number and severity of accidents depending on the light level, keeping in mind that road accidents, which may lead to casualties, fatalities and/or damaged infrastructure also bring an added economic and social cost.

Social

In motorised traffic areas road lighting can reduce the number and severeness of road accidents. Road lighting is often introduced when a particular road is not considered to be safe enough for road users. The reasons may be due to the risk of glare, mixed traffic, high traffic density or other complex elements.

In urban areas with parallel pedestrian and cycle paths or even mixed traffic, when implemented correctly, road lighting can also lead to increased accessibility, attractiveness and perceived security. Switching off road lighting in built-up areas can lead to an increase in fatalities especially for vulnerable road users.

5 Research Objectives

Description of Problem/Description of Research Need

Road lighting is important for the day to day (or night) functioning of society, primarily by ensuring that people travel safely along roadways and other infrastructure. However, nowadays such lighting has introduced new problems as there can often be lights which are on for too long, too many lights or lights which are too bright, leading to direct impacts on nature or wasting precious resources to maintain the unnecessary lighting.

There are many possibilities to reduce light pollution by implementing new lighting technologies. However, we need practical guidelines on sustainable road lighting in order to demonstrate the possible consequences that our choices will have on the environment, road safety, energy efficiency, economy, and other relevant values. There is a need for guidelines that are practical and efficient today but can also deal with unknown challenges of light pollution in the future. The impact of road lighting on nature and skyglow should be significantly reduced by introducing the guidelines, whilst road safety is increased, people feel safe in public space and energy consumption is reduced.

Expected Outputs

- **Practices and Research:** A comprehensive overview and analysis of practices and research across European NRAs on how we can decrease the negative impacts of light pollution on nature, with an emphasis on practical applications. This also includes:
  - differences in the use of recognised standards and policies, including where, when, how and at which level a road must be illuminated;
  - an analysis of research on road lightings effect on road safety and differences between the justifications of NRAs national road lighting strategies;
  - practices from local/regional road authorities;
  - a short overview of practices and research across European NRAs sister transport agencies (especially railways, airports and container ports) on how to decrease the negative impacts of light pollution on nature;
  - a short analysis of sustainable new products and technical innovations to decrease the negative impacts of light pollution on nature;
  - the use of digital tools in planning reductions in light pollution;
  - and analysis of the issue of decorative lighting along roads.

- **Guidelines**: The Guidelines arising from this research should primarily show how different tools to reduce light pollution can make road lighting sustainable by balancing biodiversity, energy efficiency and our need for road safety across various road types and users. The guidelines must also include:
    - considerations of EU targets for energy efficiency,
    - alternative ways to see more, as for example grazing lighting system, reflectors, anti-glare systems, speed limits etc.
    - more briefly other relevant considerations that must be considered to make quality lighting, in terms of health, aesthetics, night sky and astronomy,
    - establishing thresholds for different lights and what are the negative impact on the environment and the night sky,
    - recommendations for possible new pilot projects,
    - and a digital tool for the NRAs to use the guidelines in a practical and efficient way.

  At the end of the project the applicant foresees a training on how to use the digital tool. The use of the tool should be intuitive, but a user manual will help the operator of the tool. This tool must be:
    - easily implemented in any NRA, independently from others;
    - customable and maintainable by an NRA which means guidelines and good practises can be added/deleted;
    - customizable in order to allow potential translations to other languages.

- **Pilot Project**: Testing new ways to allow road users to see more with less light pollution, less energy consumption whilst also maintaining road safety on a small basis from which the results can be extrapolated to a larger scale.
    - The pilot project will be chosen from the list of recommendations for possible new pilot projects in the guidelines.
    - The kind of pilot project will be chosen in discussion with the PEB.
    - The pilot project will be carried out in at least two of the funding countries.

6 Overview of current and previous activities

A general overview of current and existing relevant research projects undertaken across Europe and other sources of information are outlined in Appendix A. These resources and subsequent reports will provide the starting point for proposals submitted in response to this Call and proposals will be evaluated on this basis. **Applicants must not duplicate existing results or ongoing projects and should inform the tenderer of any similar proposals currently under submission for funding by other publicly funded calls.** Proposals should take full account of the outcomes and state-of-the-art identified in these projects listed below. Failure to take account of available research conclusions or notify the evaluators of similar proposals submitted to other funding schemes will disqualify proposals from this call or lead to termination of an awarded contract as will any form of collusion between competing proposals.

7 Additional information

The aim of this Transnational Road Research Programme is to provide applied research services for the benefit of national road administrations in Europe. The Call is open to any contractor but lead entities must be established in Europe. Applications using the templates provided must be submitted by the applicant.

The expected duration of this programme is 36 months. The target dates within this programme are as outlined in the Guide for Applicants.

The duration for individual projects can be up to 24 months within the programme timescale and commensurate with the tasks envisaged.

The programme language is English: only proposals submitted exclusively in English are acceptable.

The research budget provided by the participating national road authorities for this research programme is (to be determined).

Please refer to the Guide for Applicants (GfA) for full details of how to submit proposals in response to this Call. Submissions using the templates provided must be made electronically using the CEDR Tenders portal (https://tenders.cedr.eu). Submissions received after the deadline cannot be considered.

Appendix A: Existing projects and resources

There are lots of publications regarding light pollution and the effect on different species. In the list below we have included publications and projects

- from CEDR, EU, CEN and CIE,
- financed by a European NRA,
- especially relevant for road lighting,
- and road safety studies (some meta-studies, an overview of CEDR practice and a publication especially relevant for light pollution reduction measures).

Europe wide

Publications

- EU
  - FUTURE BRIEF: Light Pollution: Mitigation measures for environmental protection – Issue 28 (europa.eu)
- CEN
  - EN 13201 Road Lighting
- CIE
  - CIE 150:2017: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations, 2nd Edition
  - CIE 126:1997: Guidelines for minimizing sky glow
- CEDR
  - Survey on Lighting and light pollution on major road infrastructure, CEDR Environmental Working Group, 2022
  - Survey on lighting, Ministerio de Transportes, Movilidad y Agenda Urbana (Spain), 2023

Ongoing projects

- EU-funded
  - CORALAN: changes in coral reef communities exposed to artificial light at night (Horizon 2020)
  - ENLIGHTENMe: innovative policies for improving for improving citizens health and wellbeing addressing indoor and outdoor lighting (Horizon 2020)
  - PLAN-B Adverse impacts of light and noise pollution on terrestrial biodiversity and ecosystems
  - AquaPLAN: Aquatic pollution from light and anthropogenic noise: Management of impacts on biodiversity
- CEN
  - CEN/TC 169/WG 15 “Assessment and control of obtrusive light in outdoor spaces"

National programmes

Publications/websites

- Sweden
  - Sustainability | Free Full-Text | Ecological Impact of Artificial Light at Night: Effective Strategies and Measures to Deal with Protected Species and Habitats (mdpi.com)
  - Effects of anthropogenic light on species and ecosystems | Request PDF (researchgate.net)

    - Energies | Free Full-Text | Synergies and Trade-Offs Between Sustainable Development and Energy Performance of Exterior Lighting (mdpi.com)
- Hungary
    - Spectral optimization of beacon lights for the protection of night-swarming mayflies - Mészáros - 2021 - Insect Conservation and Diversity - Wiley Online Library
- Belgium
    - Onderzoek naar nachtelijke verlichting op gezondheid en biodiversiteit - Provincie Antwerpen
    - https://wegenenverkeer.be/wegen/openbare-verlichting
        - Lichtvisie gewestwegen
        - Lichtvisie snelwegen
    - Vademecum Natuurtechniek
- Germany
    - WEB_DIN_A4_EUROBATS_08_ENGL_NVK_28022019.pdf
- Ireland
    - Review of Motorway Junction Lighting Energy Reduction Pilot Project (tii.ie)
    - Design of Road Lighting for the National Road Network DN-LHT-03038 (tiipublications.ie)

Traffic safety publications

- CEDR
    - Road Lighting & Safety, May 2009
- UK
    - The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis | Journal of Epidemiology & Community Health (bmj.com)
- Belgium
    - Installation of lighting & Improvements to existing lighting

Ongoing projects

- Germany
    - Tatort streetlight - ACTION Project
    - BALIN - Insect protection at railway stations through insect-friendly lighting
    - Glare assessment for the reduction of light emissions caused by road traffic-related light emissions (FE 03.619)
    - Quality assurance of lighting in the case of conversion and retrofitting required under species protection law (FE 77.0605)
    - Limitation of emissions caused by street lighting - Limitation of illumination on surrounding properties (FE 77.0604)
    - Optimisation of street lighting for speed 30 zones and fast cycling traffic (FE 77.0603).
- Norway
    - Forskningsprosjektet Lysmiljø | Statens vegvesen
- The Netherlands
    - Light on Nature (lichtopnatuur.org)
- Denmark
    - Vejdirektoratet sparer på energien på vejene | Vejdirektoratet
- Italy
    - Pilot 5 - CIRCUIT project, Solution 1
- Ireland

    - Home - Public Lighting
    - Energy Efficiency Lighting Programme | Our Projects | Uisce Éireann (water.ie)
- Belgium
    - Homepage | Life B4B