CEDR TRANSNATIONAL ROAD RESEARCH PROGRAMME
Call 2019

Renewable Energy in Road Infrastructure

CEDR Transnational Road Research Programme
funded by

Austria, Belgium (Flanders), Germany, Ireland, Netherlands,
Norway, Sweden, United Kingdom

Description of Research Needs (DoRN)

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Table of contents

1 General Introduction .................................................................................................................. 1
2 Introduction to Call 2019 ........................................................................................................ 1
3 Aim of the Call .......................................................................................................................... 2
4 Reasons for the Transnational Road Research Programme .................................................. 3
5 Research Objectives ................................................................................................................ 3
   5.1 Analysis of renewable energy applications ....................................................................... 4
   5.2 Analysis of business case and market models ................................................................. 5
   5.3 Governance, organisational and legal issues ................................................................. 54
6 Overview of current and previous activities .......................................................................... 8
7 Additional information ............................................................................................................ 8

Appendix A: Existing projects and resources ............................................................................. 9

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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 2019 launched by the Danish Road Directorate on behalf of the Conference of European Directors of Roads (CEDR). CEDR is an organisation that brings together the directors of 27 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.

The CEDR Governing Board agrees that innovation is a part of the CEDR strategic objective ‘to help NRAs to keep ahead of the curve, anticipate future trends and prepare them to face new challenges’ and that innovation will shape NRAs’ future core business as well as the legislation that frames their activities. In this context, CEDR has established a Working Group (WG) to monitor European research activities and to advise the CEDR Board on issues relating to research. WG Innovation responsibilities include dissemination of research results as well as initiating research programmes that support CEDR members in current and future situations.

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

- WG Innovation only proposes suitable research topics and identifies good research proposals;
- WG Innovation presents 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 organisations 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 taking part in the programme.

2 Introduction to Call 2019

The CEDR Transnational Research Road Programme was developed to fulfil the common interests of the National Road Administration (NRA) members of CEDR. The participating NRAs in this Call are Austria, Belgium (Flanders), Germany, Ireland, Netherlands, Norway, Sweden, United Kingdom. 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 members of the PEB. The PEB will designate one of its members to act as PEB chair.

WG Innovation has, on behalf of CEDR, appointed a Programme Manager (ProgMan) to take over the administration of this Call for Proposals. For this programme, the ProgMan will be the Danish Road Directorate, Denmark. The responsibilities of the ProgMan include the 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 and under the
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 consortia in response to this Call for Proposals. Consortia must be led by a legal entity from a European country (based on CEDR’s definition of Europe) and consist of at least two legal entities from two different countries. Individuals and organisations involved in the formulation of the Call specification 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.

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

The aim of this programme is to identify, consider and gain a greater understanding of existing renewable energy generation with regard to application on or nearby assets of National Road Authorities (NRA). In this way, NRAs can make more informed choices and contribute to the energy transition in a most cost-effective way. This research programme will examine the following three sub-themes: (i) an overview of renewable energy applications in different NRA topologies and assets; (ii) an analysis of business case options and typical applications; and (iii) Governance, organisational and legal issues regarding renewable energy at NRA assets and land.

This CEDR Research Programme aims to help road authorities with:

1) An overview and analysis of renewable energy applications in different NRA topologies and assets. The overview should include a multi-criteria analysis of the technologies and their impacts in different situations on a wide variety of aspects including the management of the NRA asset, biodiversity, risks (e.g. vandalism), glare (road user’s safety), etc. Many studies have been conducted on technological performance and options of renewable energy: the overview should be built upon the PIARC Positive Energy Roads Project (2019) and others as relevant.

2) An analysis of business case and market models. The aim of the analysis is to enable NRAs to implement projects or programmes in their own network and to know and understand which stakeholders can play which role.

3) Governance, organisational and legal issues regarding renewable energy at NRA assets and land. The aim is to develop a better understanding of what opportunities regarding renewable energy on NRA’s assets exist under current governance and
The scope of this programme includes both renewable electricity and renewable heat generation, and storage, in applications on NRA assets: these include road and road elements, adjacent land, tunnels, bridges and other operational assets. In this programme, we exclude offices from the scope. Concerning the technological options of renewable energy production, this programme is not including new options or options with a low Technological Readiness Level (TRL). The scope of energy production is not merely to meet the demands of the NRAs, but also of e-mobility, the constructors of roads, and in general, delivering to the electricity grid or heat network and in that way contribute to a larger share of renewables in the energy mix. However, the different possible energy users should be taken into account when analysing the three sub-topics outlined below, as they might lead to different choices regarding business cases, scale and project design.

4 Reasons for the Transnational Road Research Programme

NRAs face several challenges related to placing, or allowing the placement of, renewable energy installations on their assets and land. The transition towards more renewable energy generation is part of a larger effort and ambition on climate goals (Paris Agreement, 2015; European Commission, 2019). This transition would require, especially in topologies without large hydro-power options, large amounts of land, e.g. for PV or wind farms. NRAs own asset managers throughout their countries and are looking for ways to use the land more efficiently while contributing to the sectoral climate goals.

Studies on the potential of mature renewable energy production technologies are already being conducted. A lack of knowledge about the technologies themselves is not the core problem: however, an overview and analysis of applications or possible applications of these technologies on NRAs’ assets is needed to support and improve decision-making. Furthermore, European NRAs are not familiar with the legislation that is strongly regulating the energy and especially the electricity market (e.g. EC 2009/72 and 714/2009 in particular, with recent proposed packages). This lack of experience and understanding of opportunities within this legislation can lead to avoiding big projects or to inefficient (internal or external) early decision-making.

One of the challenges regarding renewable energy installations is that European NRAs, as government authorities with a certain role, are not allowed to produce energy on the electricity market. This means that in most cases multiple stakeholders will be involved in renewable energy products when connected to the energy market. NRAs currently struggle to design good multi-stakeholder approaches, in which risks and profits are shared and the NRAs responsibilities as well as societal stakes are included. Some larger projects are currently prepared in, for example, the Netherlands. At least one large project will include a power purchase agreement (PPA) with the NRA: others are designed more as a lease contract with certain conditions on the contractor. All projects follow a site-specific approach and much is learned on-the-job. A broader understanding of not only governance and legislation, but also stakeholder participation, including possibilities for financial participation of stakeholders currently not involved, would also benefit decision-making on allowing or participating in renewable energy projects by NRAs.

5 Research Objectives

The research objectives of this DoRN are described in following three separate sub-topics:
- Analysis of renewable energy applications in different NRA topologies and assets
- Analysis of business case and market models applicable to different NRA scenarios
- Governance, organisational and legal issues regarding renewable energy at NRA’s assets and land.

5.1 Analysis of renewable energy applications

Description of Problem:
187 out of 195 countries, including the EU Member States, are engaged in the Paris Agreement 2015 to contribute into curbing global warming. The EU has incorporated this into the “2030 Climate & Energy Framework” (EC, 2019) and has committed to reduce emissions by 40% (in comparison to 1990) by 2030. Based on this objective, all NRAs have internal or external targets to reduce their own energy use as well as their CO₂ emissions.

Considering that NRAs manage a large infrastructure including a significant amount of land alongside their road infrastructure, it can be safely assumed that there is a huge potential for generating renewable. Several NRAs are interested in mapping this potential. However, at present, there is no clear view on:

- existing renewable generation and storage technologies in combination with their potential application on NRA land and assets;
- the pros and cons in different situations, topologies and elements;
- locations to consider concerning these technologies.

For these reasons, many valuable opportunities are lost. This research has been formulated with a goal to investigate the potential of different technologies and applications, compare them and map their potential so that a cost-effective roll-out of projects on a larger scale can be made possible. It is not the aim to contribute to the development of new technologies but to focus on existing technologies.

Expected Outputs:
The following outputs are expected in order to determine what opportunities cannot be ignored and what developments must be followed but are at this moment not mature enough:

1. A multi-criteria analysis of all existing types of installations for green power generation and storage and their respective applications. This should take account of the most common topologies of the European landscape, weighted relative to several relevant items such as power output, investment cost, maintainability, vandalism, usability in remote locations (transmitting possibilities), impact on ecological systems, impact on road safety, etc (this list is not exhaustive). All weighting factors must be described in detail.

2. A detailed description of all technologies for renewable power generation and storage and all their possible applications, with pros and cons, limitations, (technical) points of attention, available standards, possibly indicating where standards currently provide barriers or could be nuanced or improved.

In relation to available technologies, it must be noted that many comparative studies on PV and wind technologies are available. However, in the context of application on NRA assets,
important trials are outdated (e.g. Renewable Energy Generation in Highway Situations, 2004, UK), or include very innovative options in a pilot approach. This research aims to determine market-ready scaled-up technologies.

5.2 Analysis of business case and market models

Description of Problem:
NRAs in Europe are informed about their contribution to achieve the commonly agreed climate goals in the “2030 Climate & Energy Framework” (EC, 2019). While NRAs are willing to put effort into supporting the generation of renewable energy, they expect to be forced by their governments to contribute to de-carbonisation and considerable reduction of CO₂ emission.

For several reasons, most notably to save time, to avoid wrong decisions and to benefit from experiences of other organisations, this research is expected to develop business cases which NRAs can apply depending on specific and general conditions in terms of national laws, regulations and standards. As a common approach, the European regulations for the energy market shall be applied (see sub-topic 3 below).

Expected Outputs:
The research shall result in several business cases or business models to allow NRAs to implement projects on their assets and land, either by themselves or by cooperation with local or international partners. The desired outcome of a business case is that all involved partners are aware of, and share benefits and risks from the project.

Most NRAs own land alongside their road infrastructure. These areas, and other locations such as tunnel roofs, buildings, etc, present opportunities for energy generation. It is likely that different business case models need to be investigated and presented for different situations.

This sub-topic is strongly interlinked with sub-topic 3 as the business cases and contract models could be made stronger and more elaborate if certain boundary conditions are known and adapted, along with analysing standards and governance knowledge specifically for NRAs’ situations and roles.

Partners in a business case model of renewable energy generation and storage on NRA assets, could include all companies and organisations that play or could play a role in energy generation business.

The research should also elaborate on the following fields of energy end-users:

- Generation and provision of energy for the operation of the road network, e.g. for tunnels, lighting, operational buildings, charging of own e-mobility fleet, etc.
- Generation and provision of energy for public charging stations, hubs for e-mobility on or near the NRAs road network.
- Generation and provision of energy for feeding into the grid of several suppliers - no specific end-user but operating on the European energy markets and grids.

The expected output include at least the following:
The required general framework for a specific business case.

The conditions under which business case can be best used.

Identification of the partners and stakeholders for the different applications and business models and their specific roles, constraints, etc.

An overview on how generated energy can be charged and by whom.

The existing legislative framework that needs to be considered by NRAs, partners and stakeholders to assure good decision-making and choosing the best business model in each situation.

A policy proposal or governance recommendations how to apply specific business cases.

Recommendations for project implementation based on experiences already accumulated by others, including long- and short-term land lease contracts, power purchase agreements, remote installation for direct energy use, etc.

A flowchart to help NRAs to estimate the potential of their assets (grounds and/or infrastructure) on generating/storing energy with the different available technologies, resp. applications (see also sub-topic 1).

5.3 Governance, organisational and legal issues

Description of Problem:

An NRA can choose to allow renewable energy on their property for several reasons:

- For very remote areas, local renewable produced energy might be the only cost-effective option without a grid connection;
- On tunnels, PV electricity production and the electricity demand are almost in sync;
- In more densely populated spaces, land adjacent to roads might be attractive for third parties to lease and produce renewable energy and either sell this to the energy market or directly to (industrial or public) consumers via a Power Purchase Agreement (PPA);
- In general, to contribute to national and international renewable energy goals

In sub-topic 2, different energy end-users from a NRA perspective are defined – see above. Most NRAs are not allowed to operate as an energy producer. It is therefore viable to know what options do exist and where and which partners are needed if the position of the NRA is restricted in certain energy producing situations.

The energy market is regulated by EU legislation as well strong regional or national governance influence. However, amendments, solutions and reforms in legislation are possible at both European and Regional (energy market) level. NRAs would be greatly helped by information on the governance and legal options that exist to allow renewable energy production by third parties as well as production by NRAs for specific end-users. While some research has already been carried out in this area (see sub-topic 1 and references), the governance and legislative perspective is often neglected or difficult to understand on an applicable level for NRAs. This research is intended to focus on:

- How can renewable energy use/production support the responsibilities of NRAs;
• What legislation and governance arrangements need to be reviewed to allow NRAs to generate energy;
• What governance and legal restrictions exist and how can these be adapted or integrated.

Expected Outputs:
A good understanding of energy legislation in relation to NRAs is a fundamental step to support better decision-making and better projects concerning renewable energy at our assets. With the rise of renewable energy applications on a larger scale, new concepts and governance frameworks are needed to facilitate the implementation of renewable energy in concurrence with road infrastructure. There are already promising legislative concepts, e.g. the German "Mieterstromgesetz", a tariff promoting energy production and consumption and aiming to lessen the pressure on grid capacity. Other concepts include Power Purchase Agreements (PPA) with a public aspect. These existing concepts could be used as a base for suggestions for a governance and legislative approach on the European level that would be in line with the European policy on energy.

This sub-topic is strongly interlinked with sub-topic 2 as the business cases and contract models could easily be made if the limitations are known and understood.

Outputs should include:

1. A background analysis of whom can currently act as an energy producer and who cannot. Outputs should include examples of the limitations of producer/consumer relations and public-private considerations.

2. An analysis of the energy legislative and regulatory frameworks across Europe with respect to identification of barriers and best practice examples on renewable energy production and/or storage.

3. An analysis of if energy produced by NRAs could be fed into the grid and how this could be facilitated e.g. by (public-private) Power Purchase Agreements, including an analysis, understanding and explanation of the barriers existing in the legislative framework.

4. Analysis of current governance of Energy vs Road projects, addressing land lease of public authorities to third parties, addressing time-frame and identification of issues, including societal issues, e.g. participation of residents in local projects.

5. Analysis of current legislation under review and suggestions to learn or support a clear way of working for road authorities. This might include a workshop and the production of an e-learning system for road authorities to update their knowledge on renewable energy and governance/legislative issues in a practical way (including which developments to monitor, as changes occur).

6. A clear guide of what governance and legislative options and choices road authorities have regarding renewable energy initiatives.
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. Proposals should be based on 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.

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 consortium that is led by a legal entity established in Europe. Applications using the templates provided must be submitted by a coordinator of a consortium of at least two independent organisations from different countries. A maximum 75% of the workload can be assigned to one partner.

The expected duration of this programme is 48 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.

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

The budget provided by the participating national road administrations for this research programme is EUR 1,280,000. The provided budget will, apart from research costs, cover management costs, dissemination activities and unforeseen costs. For this CEDR Call 2019: Renewable Energy in Road Infrastructure, the research budget is EUR 1,185,000.

The expected outputs should follow CEDR Guidelines which include three types of reports: high-level strategic reports, technical reports and contractor reports. The outputs from a CEDR funded project that is authorised by an external contractor are normally presented through CEDR contractor reports. However, research outputs could take the form of a full CEDR report as well.

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 iBinder system. Submissions received after the deadline cannot be considered.
Appendix A: Existing projects and resources


