HERMES

Integrated evaluation of energy and emission reduction potential and management strategies for urban road systems

Programm / Ausschreibung	ENERGIE DER ZUKUNFT, JPI Urban Europe, Joint Call 2017	**Status**	laufend
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ABOUT

HERMES was a collaboration with partners in Norway (SINTEF and NTNU), Austria (Graz University of Technology and Zement + Beton Handels und W GmbH) and China (Whuhan University of Technology and Shandong University of Science and Technology). Project leader is SINTEF with Terje Kristensen, PhD.

The HERMES project was based within the project type applied research and the project type innovation and implementation, since the main focus was to improve how we conduct a life cycle assessment (LCA) for road constructions. Furthermore, within the project a lifetime prediction of the durability of green asphalt was explored. By developing a methodology for assessing the sustainability of asphalt technologies and rate different green solutions the urban circular economies was strengthend. The project also discussed and suggested a common system boundary for conducting LCA in the planning phase of a new infrastructure project.

Overall, more than 30 scientific papers were published during the project lifespan.

PROJECT

The HERMES project relates to the JPI Urban Europe's Strategic Research and Innovation Agenda (SRIA 2.0) on multiple fronts, but in particular: Sustainable land-use and urban infrastructures. The project aimed to identify and develop a standardized method for estimating the environmental life cycle impact of roads in urban areas. If we are to get a transparent and internationally comparable account on the impacts of urban infrastructures, and in our case road construction, we saw a need an internationally accepted method on what should be included in the estimations. One of the first goals, where to develop a joint method and identify where the efforts for innovation and policies should be aimed at to lower the environmental impacts of road infrastructures. Our findings can apply, not only to urban road construction, but also in peripheral and periurban areas. We think that transnational goals regarding emission reduction and how to achieve are easier to reach if actors in the field are all moving towards the same goal and along the same path. We believe that the HERMES project has contributed to this.

The deliverables promised by the project can be summarized by the following:

1. Assessment of the existing methodologies and available tools.
2. Analysis of the energy consumption and emissions of greenhouse gases from urban roads construction and maintenance.
3. LCA focusing on waste from asphalt pavements.
4. Relationship between different technologies, the greenhouse gas and pollutant emission
reduction potentials of the roads.
5. Analysis of the emissions VOCs from urban roads construction and maintenance.
6. Guidance document on the greenhouse gas and pollutant emission reduction potential of pavement technologies – a policy summary of applicable results.

Overall, we achieved our goals, and delivered a substantial contribution to the scientific body on this topic. The dissemination-list (with over 30 publications) has been summarized in the overview submitted to the NFR.

To guide the road infrastructure sector towards more sustainable choices, it is essential to increase the transparency and, thus, the reproducibility of scientific results. The ability to compare the results of different technological and material choices will enable road owners to reduce emissions throughout the lifetime of the road by providing accurate and usable information. We suggest that increased transparency can be achieved by providing/requesting a few essential parameters, such as a clear description of the road components linked to the FU and its aspects, the inventory database, and the impact assessment methodology.

We suggest the following: First, the scope of the study must include a clear description of the dimensions of the entire road and its components. All information should be described in a figure of a road cross-section that contains the width and thickness of the road components and layers. The elements of barriers, pipes, or lighting systems that require more descriptive details can be specified in an additional figure. In the cases where the road has different cross-sections along its length, the cross-sections must be specified. Together with the cross-section, the design parameters for which the road and its components were designed must be specified. This method of description allows the road to be easily decomposed at the component or material level.

Second, a functional unit (FU) must be defined for each road component, and together, these should be correlated to the global FU of the entire road. The next step is the creation of subsystem boundaries, whose sum composes the system boundary of the road. The inventory data must be

sufficiently precise to allow a clear link between the material flow of each road component and the associated global warming scores. In the end, the impact assessment method should be provided, and the environmental impacts for the indicators of the GWP, CED, particles, etc. of the road should be presented for the components and the road itself. This approach would allow a comparison among different road types and projects through the correct selection of the components.

The possibility of comparison across projects is not only important for LCA practitioners and in the assessment of individual projects, but it would also guide the road construction sector towards lower emissions -- by assisting in the right selection of materials and processes. The sector needs to follow a common direction to achieve the current ambitions of a 50% reduction in GHG emissions by 2050.

The potential users of this research project are mainly stakeholders of road construction projects, policy makers in municipalities and similar organizations that are responsible for developing strategic plans and project to promoting climate mitigation solutions. The project is also intended to challenge the national and trans-national policy making systems (like that of the European Union), since these often play an important role in setting up the planning framework for how to develop and access strategic plans and projects.

PROJECT ORGANIZATION AND WORK

Work Package 1 (Project management):

Objectives

Manage the project according to approved plans, guidelines and agreements; direct and coordinate the communication between the HERMES consortium and the funding agencies, within the consortium and with advisory group; monitor, track and control deviations due to progress, costs, and financial and scheduling changes; implement a proper integration, rightly develop the project works, troubleshoot, and achieve milestones and deliverables; ensure the achievement of proper quality and improvement of performances during project life
According to [A0-0], project management as a cross-cultural setting comes with several challenges, especially in terms of management expectations and communication. There appears to be vast difference in how the different teams expect management of such a project, from a detail-oriented micro-management, an ordered-based management, all the way to an intention-based leadership. Despite the differences in expectation, the group has been working well together, and the progress has been satisfactory

Outcomes

The project group has had a total of four physical meetings and four shorter online meetings during the first year of the project. The physical meetings took place in Norway, Austria, and China, while the online meetings allowed for continuous communication. Additionally, the EU-team had separate workshops and online meetings. This high meeting frequency was beneficial for determining the project's direction. However, due to the COVID-19 lockdown, communication was reduced for four months, resulting in a minor setback for scheduled tasks.

In the second year, the project group faced challenges due to the COVID-19 pandemic and various restrictions in different countries. As a result, the meeting frequency was significantly reduced for ten months. The consortium decided to work individually on separate tasks and topics related to each corresponding country. Despite these difficulties, the consortium eventually met again after ten months, and the EU team had more regular online meetings.

During the final reporting period, the group had one physical meeting and several virtual meetings. The physical meeting took place in Norway and Austria, while the virtual meetings provided further opportunities for collaboration and discussion.

Overall, the project group faced interruptions and adaptations due to the COVID-19 pandemic, but they managed to maintain communication and make progress on their tasks through both physical and online meetings.

Work Package 2 (Dissemination activities):

Objectives
The objectives of this WP are to disseminate the results of the project in its different phases to both national road administrations and relevant stakeholders within international arenas and to provide the communication and interaction with the advisory group.

Outcomes
The HERMES project successfully developed and updated a communication and dissemination plan. The plan addressed challenges in maintaining an efficient strategy and introduced a new approach to collect information from selected contact nodes. Dissemination activities targeted multiple stakeholder groups, including the scientific community, industry, advisory groups, national road administration, general public, students, and project partners.

Austrian researchers contributed to several papers covering topics such as environmental impact evaluations, materials with lower environmental impacts, and road design options. Lectures and workshops were conducted to share knowledge among project partners, students, and stakeholders. Findings and recommendations were presented to the Austrian advisory board, and a newsletter was published to raise awareness among the general public. The findings were also publishe in the ÖBV Sachstandsbericht Nachhaltigkeit in Tiefbau.

Work Package 3 (Sustainability assessment of asphalt technologies):

Objectives
The WP aims to assess the current methodologies and create an inventory of greenhouse gas and pollutant emissions from asphalt technologies
Outcomes

The aim was to conduct a comprehensive sustainability assessment of asphalt technologies. The focus on analyzing existing methodologies and identifying challenges related to sustainability evaluation. The Austrian team contributed through a Systematic Literature Review (SLR) and published their findings and recommendations in a peer-reviewed paper. The recommendations covered various aspects of the LCA method.

The Austrian team conducted an extensive analysis of peer-reviewed papers and norms to classify aggregates, asphalt and concrete mixtures, and road design options. Also materials and equipment inventory, carbon emissions sources, and the correlation between road grade, mixtures technologies, and design options were investigated. The Chinese partners contributed by identifying energy consumption factors, emissions sources, and developing a dynamic inventory of emissions from urban road construction and maintenance.

The findings and results underwent validation processes involving partners and the Austrian advisory board, ensuring their credibility and acceptance.

Work Package 4 (Life cycle assessment of urban roads)

Objectives

The objective of this WP is to determine the system boundaries and accounting ranges, and to build an inventory for life cycle analysis.

Outcomes

In Work Package 4, the focus was on conducting a comprehensive life cycle assessment (LCA) of urban roads. Tthe team analyzed the energy consumption and waste discharge associated with the production, construction, operation, and dismantlement of asphalt pavements. Through a systematic literature review, they identified gaps and issues in applying widely accepted and useful in this field. The method will be utilized to calculate the environmental impacts of real case studies, with the results summarized in a paper and in the ÖBV Sachstandsbericht, where the state of the art of construction materials and support for LCA methods of roads were provided.

Data was collected for the production, construction, operation, and dismantlement stages of asphalt pavements. The focus was on identifying energy consumption and emission sources, involving selecting a specific case study for analysis.

Building upon the recommendations for harmonized LCA application, inventory formulation, and materials data collection , a life cycle assessment was conducted to determine the environmental impacts of a design option representative of the Austrian context.

Work Package 5 (Greenhouse gas reduction of urban roads)

Objectives

The objective of this WP is to develop the HERMES tool including considerations on the pavement service life and new technologies.

Outcomes
Work Package 5 (WP5) focused on supporting and enhancing existing tools rather than developing new ones, based on previous findings.

An assessment was conducted to analyze the impact of maintenance schedules and factors on greenhouse gas emissions, specifically considering various design solutions and mixture technologies. The results, presented in a study, highlighted the significant disparity in environmental impacts between scenarios with different traffic loads and identified optimal wearing course thickness. Data on maintenance timing and scenarios were obtained from the Austrian advisory board during a workshop. In this work package, the partners agreed to focus on improving existing tools rather than creating new ones, ensuring efficient utilization of resources and expertise.

Work Package 6 (Case studies on emission reduction of urban roads)

Objectives
The above-mentioned emission reduction potential evaluation method and management policies will be applied to at least one Chinese and one European case.

Outcomes
In WP6, our focus was on searching for case studies related to emission reduction on urban roads. These case studies were assessed using the harmonized method and databases from WPs 3 and 4. We aimed to select comparable cases to minimize the influence of external variables. We also evaluated various road design options based on the Austrian Norm RVS-03.08.63, comparing the results with international roads documented in the literature. The evaluation included the often neglected auxiliary components of the road, revealing their significant impact on environmental effects. A paper presenting the results is currently in progress.

PUBLICATIONS

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