Oregon Department of Transportation

**Research Stage 1 Problem Statement**

**Number 26-18 – "EPD Benchmarking And Quality Control - A Process to Connect Asphalt Mix Properties And Parameters With EPDS to Reduce Asphalt Mix Production Emissions"**

Use this form to propose new ODOT research. Research projects start with the identification of a specific problem affecting Oregon's transportation system. This form should be limited **seven pages** at 12 pt font for ADA purposes. At this stage, we are looking to identify the topic and do not need a detailed project proposal. (Given the agency workload the expectation is that **this form should take any one individual a couple of hours to complete,** extensive pre submittal collaboration is not required.)

**PLEASE READ THE RESEARCH PROBLEM STATEMENT GUIDANCE ONLINE BEFORE STARTING THIS FORM.**

**PROPOSED TITLE: EPD BENCHMARKING AND QUALITY CONTROL - A PROCESS TO CONNECT ASPHALT MIX PROPERTIES AND PARAMETERS WITH EPDS TO REDUCE ASPHALT MIX PRODUCTION EMISSIONS**

**1.** Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

To encourage and provide incentives for the industry and DOTs to reduce A1-A3 greenhouse gas (GHG) emissions without sacrificing long-term performance, the connection between asphalt mix ingredients, their potential impact on mix costs, emissions, and potential long-term pavement performance must be well understood. The major purpose of this proposed research project is to connect the research findings from previous ODOT research projects (including the Balanced Mix Design (BMD) efforts and the findings from the previously proposed research idea) with local life-cycle assessments (LCAs) to develop an Environmental Product Declarations (EPD) database with the following info:

- Mix constituents – The recipe: binder content, binder grade, RAP content, additives, etc.
- Volumetric information for the asphalt mixture
- Cracking, rutting, and moisture susceptibility test results from the ODOT's and OSU-AMaP's databases
- Some production-level data (raw material extraction and processing, transportation, production temperatures, moisture, plant energy types and sources, etc.)
- Field performance – expected performance determined by Mechanistic-Empirical (ME) pavement design methods and using the field performance data from ODOT's Pavement Management System (PMS)
- Upfront project costs and life-cycle costs

Based on the test results and findings from the ODOT research projects SPR801, SPR852, and SPR 862, an Asphalt Materials database is being developed in SPR852. LCAs for different Balanced Mix Design (BMD) mixes are also being conducted in SPR852 and SPR862.

**A Comprehensive Decision-Making Software Package**

Using all the compiled information, ***A Comprehensive Decision-Making Software Package*** will be developed to conduct statistical analysis by combining all mix properties, performance test results,

costs (upfront and LCCA), plant-level production data, asphalt layer density data from construction, and EPD outputs to provide recommendations for low-carbon materials while considering all factors listed above. The process will provide recommendations for the contractor and ODOT to modify the asphalt mix or the production process to reduce emissions (which will be from the developed EPDs) while keeping the expected asphalt material performance above the thresholds set in the BMD research project (SPR852). Three hypothetical (example) recommendations from the decision-making tool can be: *i)* increasing RAP content by 5% will not result in cracking failure while it can reduce the emissions by 9%, *ii)* RAP content can be increased by 10% while meeting the cracking resistance thresholds but a rejuvenator to replace 1.5% of the asphalt binder needs to be used, *iii)* reducing the virgin binder content by 20% can reduce emissions by 5%, but the aggregate angularity must be changed by using a special rock crusher (several other potential methods to improve the performance and reduce the A1-A3 emissions will also be provided by the tool).

**Benchmarking Process**

House Bill 4139 required forming a technical advisory committee (TAC) to develop different strategies to reduce Oregon DOT's greenhouse gas (GHG) emissions. Following the directives of the House Bill, a committee was formed by ODOT in 2023 to address several needs for reducing ODOT's GHG emissions. ODOT will report the progress of the TAC annually to the Oregon Transportation Commission and an interim committee of the Legislative Assembly related to transportation. One major item in the TAC objectives is to implement an Environmental Product Declarations (EPD) program that will require measuring and evaluating the GHG emissions released during the material acquisition, transportation, and production of the paving materials. To address the goals of House Bill 4139, probabilistic *(by considering potential variability in the production process and material transportation)* and deterministic approaches need to be combined with advanced statistical analysis to determine GHG thresholds for asphalt mixture production. This benchmarking process for EPDs can also be structured by following the feedback from this software. The software will also evaluate and quantify the impact of the factors that cannot be controlled by the producers (such as climate, geology, and location impacts).

In this proposed research project, the benchmarking methodology recommended by the National Asphalt Pavement Association (NAPA) will also be used as a reference for improving the outcome of the benchmarking efforts to make it more equitable for all stakeholders and to achieve the best outcomes. Based on the feedback from the sensitivity analysis conducted with the decision-making software, collected industry EPDs, and the methodology recommended by NAPA, a statistical analysis method for benchmarking will be developed.

**EPD Quality Control and BMP Document Development**

After implementing the EPD program in Oregon to address House Bill 4139, several EPDs will be produced and submitted by the asphalt industry. At the initial stages of the program, errors and inaccurate assumptions are expected in the reported EPDs. A statistical analysis software that can detect outliers in the reported EPDs will be developed. The software will flag EPDs with potential errors, which can be checked in more detail to identify issues. This process can be structured like a feedback loop to train the developer of the EPDs to avoid any future errors. Based on the observations and analysis, the plants with the lowest GHG emissions can also be identified as a part of this process. Those plants can be visited to find the major reasons for low emissions. Based on the findings, a **Best Management Practices (BMP) document** will be developed and presented to the industry through webinars/meetings for training.

**LCA and EPD Development Process for Pavement Preservation Strategies**

Since the cost of paving with asphalt concrete materials is continuously increasing, lower-cost options for pavement preservation, such as chip seals, are starting to become more critical. The major advantage of pavement preservation strategies, besides the high benefit-to-cost ratio, lies in the effectiveness of the process in sealing the surface cracks and improving the condition of the pavement surface by introducing a protective layer, which also improves ride quality and user comfort in many cases. Since the percentage of chip seals and other pavement preservation strategies in the overall pavement maintenance and rehabilitation is expected to increase within the next years, quantifying the impact of pavement preservation strategies on GHG emissions is important. There are almost no research studies in the literature (except a few limited analyses) focusing on quantifying the GHG emissions for pavement preservation strategies. This proposed research study would also develop a process and tool for conducting local LCAs for pavement preservation strategies.

**2.** What **final product or information** needs to be produced to enable this research to be implemented?

This proposed research project would be structured with software development, database creation and management, data collection, statistical analysis process, and AI-based learning algorithms embedded in the software package for auto-retraining the algorithms with the entry of new data after the implementation of the software with the process. Training ODOT and the industry in software use and process would also be a major component of the effort.

The major products from this proposed research project would be:

- *A Comprehensive Decision-Making Software Package* to help develop asphalt mix adjustment strategies by following the BMD methods and the EPD outputs to reduce GHG emissions. The tool will also have cost calculation components.
- A process and tool for benchmarking.
- Major asphalt mix design and production level recommendations for ODOT and the industry with several case studies to reduce GHG emissions without sacrificing long-term pavement performance.
- An EPD quality control tool and process to capture errors and develop a BMP document for plants and contractors.
- A process and tool for LCA and EPD development for pavement preservation strategies.
- A comprehensive training program for ODOT and the industry regarding the use of all developed tools, processes, and documentation.
- A comprehensive research report with a literature review, all research components and results, and major conclusions.

**3.** (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

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|---|---|---|---|
| Chris Duman | Pavement Quality & Materials Eng. | Christopher.L.DUMAN@odot.oregon.gov | (503) 559-4994 |
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| Kevin Shearmire | Sustain. Engineer | Kevin.J.SHEARMIRE@odot.oregon.gov | (503) 314-7823 |

**4.** Decision making lenses

Please complete the following three sections. Your answers to these questions will be applied on a programmatic basis to support agency decisions. Answering yes to the questions below is not required. Resolving a narrowly focused technical research problem may meet agency needs without answering yes to any of the following questions. The ODOT Research Section will seek a balanced portfolio some projects will answer yes to one of the three categories below (e.g. climate, equity, and/ or safety) and other projects in a different category.

We are looking for an overall program balance and no one project is expected to balance all categories. Generally, a research problem statement is expected to be able to answer yes with clear and verifiable information in only one of the three categories below, some projects may be able to answer yes in two or even three categories. Some projects (i.e. needs focused on specific elements of infrastructure design), may have no yes answers but may still be high value research need.

**Climate**

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. Every mile driven in Oregon is powered by a clean source of fuel. We seek research that supports construction and maintenance operations are carbon neutral and investments in mobility that support travel by low and no emission modes. While every research project may not result in a reduction in emissions, transportation investments overall support emission reductions to achieve state goals. Oregon envisions a transportation system that is resilient in the face of seismic and climate events and impacts to the degradation of the natural environment are reduced. Our vision includes a transportation infrastructure is built in a way that avoids impacts on key habitat and results in better environmental conditions for wildlife and native vegetation. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4f. Will addressing the **transportation issue** identified as a need in Question 1 develop, or validate methods for the estimation, measurement, or monitoring of transportation generated greenhouse gasses (GHG)?

☐Yes ☒No ☐Unsure

4g. If climate or GHG is not the focus of this **transportation issue** identified in this problem statement, will the research apply a GHG analysis to transportation infrastructure, planning, operations, maintenance, or materials?

☒Yes ☐No ☐Unsure

4h. Will the addressing the **transportation issue** include development or testing of construction practices, methods, or materials to establish potential reductions in greenhouse gas emissions?

☒Yes ☐No ☐Unsure

4i. Will the solving the **transportation issue** in question 1 study or support the reduction of vehicle miles traveled and single occupancy vehicle travel or support transition to electric vehicles (or other types of zero emission vehicles) or low-carbon alternative fuels?

☐Yes ☒No ☐Unsure

4j. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐Yes ☒No ☐Unsure

4k. Will the solving the **transportation issue** in question 1 lead to work that may result in better environmental conditions for wildlife and native vegetation ?

☐Yes ☒No ☐Unsure

4l. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

This proposed research study focuses on developing software tools and processes to reduce ODOT's A1-A3 GHG emissions and improve long-term pavement performance. All the strategies stated in Section 1 of this problem statement can significantly reduce A1-A3 emissions for the asphalt concrete materials that are commonly used in Oregon (responsible for more than 50% of ODOT's annual emissions). Increased use of RAP and reduced binder content can also reduce paving costs, ultimately allowing for more annual lane-mile paving with a limited budget.

According to an ODOT/FHWA research study (FHWA Climate Challenge) recently completed by the OSU-Asphalt Materials and Pavements (AMaP) research group, the cost of fuel and tire wear that can be saved by reducing current pavement roughness levels by 20% is around $73 million/year for the road users. The associated annual emissions savings are around 193,000 MT CO2/year, while ODOT's total annual emissions from all operations were calculated to be 182,592 MT CO2/year (Proudfoot and Toneys 2022). This important result shows that lowering the cost of paving materials, which is one of the major objectives of this proposed research study, is crucial in this low paving budget environment to keep the roadway roughness and rolling resistance low to reduce GHG emissions and road user costs.

## Equity

Equity can have many dimensions and impacts relating to communities, and transportation. It is important that problem statement proposals clearly explain in what capacities are equity dimensions or impacts being examined within problem statements. It is a goal of the OTP to "Improve access to safe and affordable transportation for all, recognizing the unmet mobility needs of people who have been systemically excluded and underserved. Create an equitable and transparent engagement and communications decision-making structure that builds public trust". Proposed research may have the intent of studying elements of this goal or apply analysis to specific transportation topics to ensure the resulting research recommendations is consistent with our equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

4a Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

4b If the **transportation issue** is not focused on transportation equity, will the primary topic be assessed for equity benefits or impacts within the research project?

☐Yes ☒No ☐Unsure

4c Is the implementation of potential findings from this research likely to directly involve participation from an identified group that would benefit from an equitable process or outcome?

☐Yes ☒No ☐Unsure

4d Is the intended final product or information expected to support ODOT's equity efforts (Including but not limited to supporting one of the equity related objectives of the ODOT's Strategic Action Plan or Oregon Transportation Plan) ?

☐Yes ☒No ☐Unsure

4e If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

**Safety**

Research outcomes may include interventions and countermeasures to prevent or reduce the frequency of crashes or other causes of transportation-related injury or death; or may include measures to reduce severity of injury (including prevention of death) after a crash or other injurious event. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan, Oregon Transportation Safety Action Plan and Oregon Transportation Plan.

4m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☒No ☐Unsure

4n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☒No ☐Unsure

4o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☒No ☐Unsure

4p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☒No ☐Unsure

4q. Will the solving the **transportation issue** support improving safety through **investing strategically**?

☐Yes ☒No ☐Unsure

4r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

**5.** Other comments:

REFERENCES:


1) Proudfoot, J., and A. Toneys. 2022. *Oregon Department of Transportation Operational Greenhouse Gas Reductions: Best Practices & Recommendations*.


**6.** Corresponding Submitter's Contact Information:


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**PLEASE SUBMIT THE COMPLETED FORM BY EMAIL TO: odotnewresearch@odot.oregon.gov**

This form is not a grant application or contract document. Please do not include proprietary information on this form. Once this form is received ODOT may revise and publish the problem statement. If selected, ODOT will assign investigator(s) of the department's choosing to conduct research.