Research Stage 1 Problem Statement

PROPOSED TITLE: Simple Bridge Design-Phase Tool to Quantify Embodied Carbon "Credit" from Design Optimization Using EPDs

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

Oregon House Bill 4139 requires ODOT to collect Environmental Product Declarations (EPDs) for key materials and to devise strategies to reduce greenhouse gas (GHG) emissions from construction and maintenance of the State's transportation system. FHWA and other DOTs are promoting Life Cycle Assessment (LCA) and EPDs to quantify embodied carbon and inform design decisions, but current guidance and tools are largely pavement-focused and research-grade, not tailored to day-to-day bridge design practice.

ODOT bridge designers already optimize structural systems (span layout, girder type and spacing, deck thickness, reinforcing ratios, steel grade, etc.) for safety and economy, yet we have no simple, standardized way to quantify and report the embodied-carbon benefits of these optimizations using available EPD data. The AASHTO/FHWA "Guide Specification for Conducting Life Cycle Assessment of Bridges" is rigorous but too complex for routine use without a streamlined tool and workflow. Without a simple process, LCA requirements and EPD collection are perceived as added burden, and ODOT risks missing opportunities to document and receive "credit" for design choices that reduce embodied carbon in bridge projects.

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

We need a **practical, low-burden implementation package** that converts existing LCA/EPD guidance into something a bridge designer can use in a few hours per project. The primary product is a **design-phase bridge LCA/EPD template ("credit calculator")**—likely spreadsheet-based—that uses bridge quantities already produced during design (steel weights, concrete volumes, reinforcing quantities, substructure quantities, etc.), applies a curated set of regionally relevant EPD data for covered materials (structural steel, reinforcing steel, ready-mix and precast concrete, etc.), and calculates cradle-to-gate (A1–A3) global warming potential at a minimum, with the option to report additional impacts consistent with the Guide Specification. The tool must allow simple comparison between a **reference design** and **optimized design(s)** and output a clear summary of embodied-carbon savings (e.g., kg CO_2e and percent reduction per project and per square meter of deck).

Supporting products should include:

- A concise **ODOT Bridge Design Optimization "credit" methodology** that adapts the AASHTO/FHWA Guide Specification for Conducting LCA of Bridges to a design-office level of effort (clarifying required life-cycle stages, service life assumptions, data sources, and how to define "reference" vs "optimized" designs).

- A **standard reporting template** that designers can attach to design documentation and to ODOT's HB 4139 reporting, summarizing assumptions, EPD sources, and reference vs optimized results in a format compatible with the Guide Specification's reporting requirements.
- **Implementation guidance and pilot evaluation**: recommendations on which projects should use the tool, how ODOT can incorporate documented design-phase embodied-carbon reductions into agency climate metrics and potential federal incentive programs, and lessons learned from piloting the tool on a small set of ODOT bridge projects.
  Collectively, these products will turn EPD data and the LCA Guide Specification into a simple, repeatable process for claiming "credit" for bridge design optimization that reduces embodied carbon.

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.

Name	Title	Email	Phone

4. Other comments:

Existing work on life cycle assessment of bridges and structural materials—such as FHWA's Climate Challenge, EDC-7 "EPDs for Sustainable Project Delivery," and published LCAs of steel and concrete bridges—demonstrates that design decisions and material choices can significantly affect embodied carbon. However, these efforts are either pavement-focused, research-oriented, or require specialized tools and expertise not realistic for routine bridge design. The AASHTO/FHWA "Guide Specification for Conducting Life Cycle Assessment of Bridges" establishes sound minimum criteria (75-year service life, ISO-compliant methodology, defined impact categories), but in its current form it is perceived by designers as a separate, complex study rather than an integrated part of the design workflow.

On the building side, whole-building LCA and optimization credits are more mature, with tools and rating systems that reward structural optimization (e.g., using EC3, Tally, LEED embodied-carbon credits). There is currently no analogous, simple, and standardized process for bridge structures. For ODOT, this means we are collecting EPDs and developing strategies under HB 4139 and participating in FHWA climate initiatives, yet we lack a straightforward way to use those EPDs during bridge design, quantify the benefits of optimization, and roll those benefits into agency climate reporting and potential federal low-carbon materials incentives.

Proposed research tasks (illustrative):

- **Task 1 – Scan of Existing Practice and Policies:** Review FHWA, AASHTO, and other DOT practices on bridge and pavement LCA/EPDs (e.g., Colorado, California, Minnesota, Washington), and synthesize what is most relevant and transferable to ODOT bridge design.
- **Task 2 – Simplified Methodology Development:** Starting from the Guide Specification for Conducting LCA of Bridges, develop an ODOT-specific, simplified comparative LCA methodology suitable for design offices, including default assumptions, required life-cycle stages, functional unit definitions, and treatment of maintenance and replacement for typical ODOT bridge types.

- **Task 3 – Tool/Template Development:** Build and document a user-friendly spreadsheet or equivalent template that implements the methodology, links to a curated set of EPDs or default emission factors for key bridge materials, and produces clear, standardized summaries comparing reference vs optimized designs.
- **Task 4 – Pilot Application:** Apply the tool to several recent or ongoing ODOT bridge projects (steel plate girder, prestressed girder, slab, etc.) to test usability, verify results against more detailed LCA where available, and refine data needs, defaults, and documentation.
- **Task 5 – Implementation Guidance and Training Materials:** Produce a short guidance document, example reports, and recommended updates to relevant ODOT manuals, specifications, and reporting processes so that the tool can be adopted across bridge design units with minimal additional burden.

This project directly supports ODOT's Strategic Action Plan climate goals and HB 4139 by enabling early-phase, design-driven embodied-carbon reductions to be quantified, reported, and ultimately incentivized, without requiring every designer to become an LCA expert.

---

5. State of Oregon Decision Making Lenses

State decision making lenses are a part of the state of Oregon's policy structure. State policy and federal policy are not always aligned. The state will prioritize research according to state policy, however ODOT may be required to skip prioritized proposals based on constraints placed on the use of federal funds. If state funds are available ODOT will attempt to fund prioritized research that is deemed ineligible for federal funding.

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 a high value research need.

Climate

Oregon recognizes the climate crisis and makes systemic changes to reduce emissions caused by travel. To that end, we seek research that reduces carbon emissions from construction activities and materials, and from maintenance equipment and operations. Oregon envisions a transportation system that is resilient, this means a system that is durable in the face of seismic events and extreme weather to avoid negative impacts, withstand them or bounce back quickly to resume system function. We seek research that improves the ability of the transportation system to adapt or cope with more frequent and extreme weather events. This may include innovations in data and data sharing, construction materials and project design, communication, emergency planning and response, and more. Similarly, we seek research that avoids negative impacts on key habitats and ecosystems that can buffer or reduce damage

to infrastructure and improve 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.

5a. 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 gases (GHG)?

☒Yes ☐No ☐Unsure

5b. 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

5c. Will 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

5d. Will 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

5e. Will the solving the **transportation issue** in question 1 lead to work that will support, measure, or monitor, transportation system resilience in response to expected climate events, effects, or natural disasters in general?

☐Yes ☐No ☒Unsure

5f. Will 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

5g. If you answered yes to any of the climate questions above or can provide alternative details related to climate, please provide additional information:

This proposal is climate-focused. It directly addresses embodied GHG emissions from bridge materials by creating a standardized, easy-to-use method for bridge designers to quantify and compare embodied carbon between a reference and an optimized design on each project. Currently, ODOT is required to collect EPDs for concrete, asphalt, and steel and to devise strategies to reduce associated GHG emissions, but there is no defined mechanism for bridge designers to convert those EPDs into quantified "credits" for design optimization. This research will fill that gap by: (1) defining a practical, ISO-aligned comparative LCA method suitable for bridge design practice; (2) implementing that method in a simple template; and (3) linking the results to ODOT's greenhouse gas reporting and strategy evaluations under HB 4139.

By making embodied-carbon estimation feasible within normal design timelines, the project is expected to foster more widespread use of low-carbon materials and optimized structural systems, enabling ODOT to systematically reduce embodied GHG in bridge projects and document those reductions in a manner consistent with FHWA and federal low-carbon materials programs.

Equity

Equity can have many dimensions and impacts relating to communities and transportation. It is important that problem statement proposals clearly explain the equity dimensions or impacts being examined. Oregon commits to social equity in the OTP, specifically 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*. We seek research that studies elements of this goal or applies analysis to specific transportation topics to ensure the resulting research recommendation is consistent with agency equity goals. For definitions and details please review the equity vision, goals, and objectives of the ODOT Strategic Action Plan and Oregon Transportation Plan.

5h. Is the **transportation issue** identified as a need in Question 1 specifically focused on transportation equity?

☐Yes ☒No ☐Unsure

5i. 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

5j. 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

5k. 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

5l. If you answered yes to any of the equity questions above or can provide alternative details related to equity, please provide additional information:

Equity is not the primary focus of this research problem statement. The proposed work is a technical effort aimed at giving bridge designers a practical tool to quantify embodied GHG reductions from design optimization. Nonetheless, by improving ODOT's ability to reduce embodied emissions from large bridge projects, the results will support broader statewide climate objectives that can have positive impacts for communities affected by industrial emissions and frequent construction. Any subsequent policy decisions that use the tool (e.g., prioritizing certain projects or materials) should be reviewed under ODOT's existing equity frameworks, but that level of policy design is beyond this research scope.

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.

5m. Will solving the **transportation issue** in question 1 support improving **safety culture** for either transportation workers or the traveling public?

☐Yes ☐No ☒Unsure

5n. Will the solving the **transportation issue** support improving safety through **healthy and livable communities**?

☐Yes ☐No ☒Unsure

5o. Will solving the **transportation issue** support improving safety through using **best available technologies**?

☐Yes ☐No ☒Unsure

5p. Will solving the **transportation issue** support improving safety through **communication and collaboration**?

☐Yes ☐No ☒Unsure

5q. Will solving the **transportation issue** support improving safety through **investing strategically**? 5r. If you answered yes to any of the safety questions above or can provide alternative details related to safety, please provide additional information:

Safety is not the primary objective of this project. All bridge designs will continue to meet or exceed current AASHTO and ODOT safety and serviceability requirements; the proposed research will not relax any safety criteria. Instead, it will provide a method to evaluate embodied-carbon impacts among designs that already meet safety standards. To the extent that the tool ultimately supports longer-lasting, more durable structures with fewer major interventions, there may be secondary safety benefits (e.g., reduced work-zone exposure for workers and the traveling public), but these benefits are not directly quantified in this research.

6. Corresponding Submitter's Contact Information:

Name:	Alex Lim	
Title:	Steel Bridge Standards Engineer	
Affiliation:	ODOT – Bridge Engineering	
Telephone:	971-283-5518	
Email:	Alex.K.LIM@odot.oregon.gov	

7. ODOT Sponsor Contact Information (Required if Submitter is not an ODOT employee)

[1 individual who has worked with the submitter, has **read and approves of the contents above**. Research Staff will check with this individual before the problem statement is allowed to advance. Problem statements will be disqualified if this person was not contacted prior to submittal]

Name:	
Title:	
Crew Number:	
Telephone:	
Email:	

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.