Oregon Department of Transportation

Research Stage 1 Problem Statement
Number 26-37 – "Assessment of other light colors, patterns, and combinations on construction equipment for speed reduction in work zones"

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

Flashing and colored lights are commonly used on roadway maintenance and construction equipment to gain the attention of drivers and alert them to the presence of the work operations, especially at night or in inclement weather. The light color that can be displayed on roadway equipment is regulated, with specific colors generally reserved for certain vehicles and conditions (e.g., amber for roadway equipment). Prior ODOT research has explored the influence of flashing blue lights (ODOT Work Order No. 19-03) and flashing amber/white lights (ODOT Work Order No. 19-15) on traffic speed. Additional research that explores other light color and flashing combinations, such as static or flashing green or purple lights and a combination of colors and flashing patterns, would provide ODOT with additional knowledge regarding best practices for protective lighting on equipment in work zones. Other colors and combinations may improve visibility of maintenance and construction operations and lead to lower traffic speeds around the work operations.

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

State departments of transportation across the country employ a variety of light combinations with respect to light color and flashing pattern. In some states, laws have been enacted and regulations put in place that allow and restrict what light colors can be used on roadways. Section 5 of this problem statement provides links to examples of articles, videos, laws, and regulations in other states with respect to light color and flashing pattern. Decision-making related to the use of equipment lighting requires knowledge of the influence of colored lights and light patterns on traffic speed, driver attention, and equipment conspicuity.
The proposed research would develop information that ODOT could use to support decision-making associated with the use of colored lights on roadway equipment during maintenance and construction operations. The final product would be guidance describing recommended light colors, flashing patterns, and combinations of colors for use during different types of maintenance and construction operations. The research to develop this guidance would include an initial comprehensive literature review of colored light use on roadways, especially for work operations. The research would then test promising light colors and combinations to observe their influence on traffic speed, driver attention, and equipment conspicuity. The testing could be performed in the field, in a driving simulator, or both. The results of the testing would then be incorporated into best practices for implementation by ODOT.

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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Jon Preis	Region 1 Safety Manager	Jon.P.Preis@odot.oregon.gov	503-969-1106
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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:

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:

The National Work Zone Safety Information Clearinghouse (https://workzonesafety.org/work-zone-data/worker-fatalities-and-injuries-at-road-construction-sites/) reports that in 2022 there were four work zone truck-involved fatal crashes in Oregon. The number of truck and equipment-related crashes in all states typically represent a high percentage of the total number of crashes that occur in the states. The proposed research is directly related to the safety of ODOT workers on the roadway who are operating equipment and the motorists who travel through maintenance and construction work zones. The conspicuity of equipment on the roadway is critical to motorist behavior and decision-making while driving through the work zones. The use of different colored lights, light flashing patterns, and combinations of light colors and patterns can increase driver attention to the work operations, especially during nighttime operations and when work is conducted in inclement weather. It is expected that the use of other colors such as green, purple, or combinations of colors and light flashing patterns, will prevent work zone crashes and improve roadway safety for roadway workers and the traveling public.

5. Other comments:

Examples of colored equipment lighting use in other states:

- Connecticut (green/amber): A green, yellow or amber light or lights, including a flashing green, yellow or amber light or lights or any combination thereof, may be used on a maintenance vehicle

owned and operated by the Department of Transportation, https://law.justia.com/codes/connecticut/2022/title-14/chapter-246/section-14-96q/

- Maryland (green/amber): Highway maintenance and service equipment or vehicles owned by the State or a local jurisdiction, or operating under a contract with the State or a local jurisdiction, that are equipped with and displaying yellow or amber flashing lights while in use for snow removal or the protection of highway maintenance workers may simultaneously be equipped with and display green flashing lights in a number up to the number of yellow or amber flashing lights equipped and displayed, https://mgaleg.maryland.gov/mgawebsite/Laws/StatuteText?article=gtr&section=22-218&enactments=false
- Michigan (green, amber): https://micountyroads.org/Portals/0/Documents/Committee-Files/Green%20Lights.pdf, and https://www.michigan.gov/mdot/-/media/Project/Websites/MDOT/Programs/Research-Administration/Research-Spotlights/SPR-1692-Spotlight.pdf?rev=7e2463f3a17a4f5fbfc5b12e3f5619bd&hash=1261660C389A90A44B84D804C4C62D9E
- Nebraska (blue, amber): https://nebraskalegislature.gov/laws/statutes.php?statute=60-6,230
- Ohio (green, amber): https://www.youtube.com/watch?v=a7N7ubnf6UY
- Texas (blue, amber): https://www.researchgate.net/publication/245559284_Special_Flashing_Warning_Lights_for_Construction_Maintenance_and_Service_Vehicles_Are_Amber_Beacons_Always_Enough
- Vermont (green, amber): https://legislature.vermont.gov/Documents/2024/WorkGroups/Senate%20Transportation/Bills/H.479/Witness%20Documents/H.479~Todd%20Law~Green%20Strobe%20Presentation~4-13-2023.pdf
- Virginia (green, amber, purple): https://law.lis.virginia.gov/vacode/title46.2/chapter10/section46.2-1025/
- Wisconsin (green, amber): https://wisconsindot.gov/Pages/doing-bus/local-gov/hwy-mnt/winter-maintenance/faq.aspx

Prior ODOT research:

Gambatese, J., Hurwitz, D., Ahmed, A., and Mohammed, H.A. (2019). "Use of Blue Lights on Paving Equipment in Work Zones," Final Report, ODOT Order No. 19-03, Oregon Department of Transportation (ODOT), March 2019, http://www.oregon.gov/ODOT/Programs/ResearchDocuments/ODOT19-03BlueLights.pdf.

Gambatese, J., Hurwitz, D., and Ahmed, A. (2021). "Use of Flashing Amber-white Lights on Paving Equipment in Work Zones." Final Report, Project ODOT Order No. 19-15, Oregon Department of Transportation (ODOT) and U.S. Department of Transportation, Federal Highway Administration (FHWA), July 2021, https://www.oregon.gov/odot/Programs/ResearchDocuments/FinalAmber-WhiteLights.pdf.

Other recommendations:

The American Association of State Highway and Transportation Officials (AASHTO) provides guidance on roadway operations equipment and recommends the use of amber and white lights as the primary warning light colors for highway vehicles: https://trid.trb.org/view/1372977.

6. Corresponding Submitter's Contact Information:

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