

# SPR RESEARCH PROGRAM

## SECOND-STAGE PROPOSAL SUMMARY

### PROBLEM NUMBER AND TITLE

24-22 Understanding Range and Total Cost of Ownership (TOC) of Department Owned Electric Vehicles for Vocational Use

### PROBLEM SUMMARY

Oregon needs research to investigate use of EVs, particularly for the work ODOT does. It is urgent that research be started now, to make decisions for future expenditures. ODOT is expected to transition the agency's light-duty fleet<sup>1</sup> to EVs as soon as possible (see online Stage 2 source for legislative mandates, Mission, SAP, and other references). Serious concerns have been raised recently regarding EV light-duty trucks' ability to perform as well as its fossil fuel counterpart in the field. State leaders have mandated changes to reduce Greenhouse Gas emissions (GHGs) and support climate change directives. Published data for normal-use, freight, and public transit EVs is large and has conflicting points. EV calculations and conversions between fossil fuel counterparts are becoming more available, but ODOT is missing performance data for vocational use.

### ODOT OBJECTIVES

ODOT will focus on ODOT work tasks and current use of vehicles as a baseline of energy needs and consumption. Using commercially available existing modeling software and publicly available EV data, ODOT intends to create a custom software model with usage data from ODOT specific tasks. EV analysis can be completed, and actions identified which may or may not meet performance criteria for conversion to EVs. Modelling will be verified with limited testing of actual in-field tasks (and parity analysis). An analysis from the model will identify total cost of ownership (TOC) that meets performance criteria for ODOT work. A final report of findings, with guidance and recommendations, will be published.

### BENEFITS

The primary benefit is the access to information needed to support light duty vehicle procurement decisions by ODOT. This information will assist decision makers to place purchase orders with confidence, knowing whether or not the vehicles under consideration will meet their intended use and knowing the total cost of vehicle ownership over its useful life with confidence. ODOT will have a better understanding of where EV vehicles can replace existing vehicles.

### SCHEDULE, BUDGET AND AGENCY SUPPORT

**Estimated Project Length:** 24 months.

**Estimated Project Budget:** \$194,000

**ODOT Support:** Darin Weaver, ODOT Fleet Services Manager; Amy Regimbal, ODOT EV Program Coordinator; Zechariah Heck, ODOT Sustainability Program Manager

### FOR MORE INFORMATION

For additional detail, please see the complete STAGE 2 RESEARCH PROBLEM STATEMENT online at:  
<https://www.oregon.gov/odot/Programs/ResearchDocuments/24-22.pdf>

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<sup>1</sup> Per SB 1044, a light duty vehicle includes passenger cars, sedans, station wagons, and pickup trucks with a gross vehicle rating of 8,000 pounds or less.

# SPR RESEARCH PROGRAM

## SECOND-STAGE PROBLEM STATEMENT

### FY 2024

#### PROBLEM NUMBER AND TITLE

24-22 Understanding Range and Total Cost of Ownership (TOC) of Department Owned Electric Vehicles (EVs) for Vocational Use

#### RESEARCH PROBLEM STATEMENT

Oregon needs research to investigate use of EVs, particularly for the work ODOT does. ODOT is expected to transition the agency's light-duty fleet<sup>2</sup> to EVs as soon as possible (State of Oregon, 81st Oregon Legislative Assembly, 2021). Agency fleet operators have safety concern (CNN Business, 2023) and performance questions. These include battery fires, battery range, and work application feasibility of EVs. ODOT vehicle procurement decisions are being made based on limited information. While vehicle manufacturers provide some info – typically focused on marketing – there is an absence of performance data that is relevant to the intended use of ODOT fleet vehicles. These uses include but are not limited to driving in mountainous areas with extreme temperatures, carrying heavy equipment, powering emergency response tools, powering additional electronics (e.g., amber flashing lights), towing a trailer, etc. If the agency is to successfully transition to an EV fleet, an investigation into the impacts of vocational use is needed.

Transitioning ODOT's light-duty fleet to EVs is a necessary part of the overarching vision laid out by the Oregon Transportation Commission, Oregon legislature, former Governor Brown (Brown, 2020), and current Governor Kotek ([Tina for Oregon Priorities](#)). EO 20-04 established climate goals for the State of Oregon: 45% below 1990 levels by 2035 and 80% below 1990 levels by 2050. One of the best scenarios for ODOT to achieve the State's 2035 climate goal is to use – among other actions – 100% EVs for sedans and at least 25% for SUVs and pickup trucks by said year.

Transportation-related emissions account for 40% (Oregon Department of Energy, No date) of Oregon's greenhouse gas emissions (GHGs). Specifically, ODOT completed a GHG inventory in 2021 that analyzed FY 2016-19 data. The study found an average of 39,404 MT of CO<sub>2</sub>e (standard unit for GHG accounting) are emitted from ODOT operational use of mobile and equipment fuels. This represents 73% of the GHG emissions ODOT has control over. A project advisory council listed replacing fossil gasoline vehicles with battery electric or hybrid vehicles as a top priority for the agency to pursue in order to reduce GHG emissions (Heck, 2023).

Emissions are causing the climate to warm, which leads to droughts, wildfires, and floods throughout Oregon, as well as sea level rise along Oregon's coastline. These events have a devastating impact on the state transportation system and hinders the agency's work to achieve its mission. Oregon's elected leaders have directed ODOT to be the lead state agency for transportation electrification and have told all state agencies to reduce greenhouse gas emissions wherever possible. "Electrify Oregon's Transportation System" is a key strategic outcome in the Strategic Action Plan (SAP). The SAP states: "We will support transportation electrification to reduce carbon from every mile driven" and provides this will be done by "raising overall awareness and acceptance of EVs" among other actions.

ODOT must lead by example and transition the agency's fleet to EVs. ODOT has discussed EV transitioning with DAS Motorpool (King, 2023) and discovered they have similar concerns, but no research to share. However, they are conducting data collection for their fleet and support this research effort. There are many relevant articles regarding EV usage for fleets, particularly in freight, public transit, and private usage; however, there is

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contradictory findings to calculate parity between fossil fuel vehicles and EVs, as well as methods to calculate a total cost of ownership. The transition to EVs will create ripple effects, expanding the knowledge and general acceptance of EVs and the nuances from gasoline-fueled vehicles. In turn, the proposed research will enable the agency to identify what units and applications where EVs are most suitable. Range anxiety and general unfamiliarity will be reduced by having real-world data that is applicable to ODOT work. Additionally, this will help build a culture at ODOT that is needed to achieve the agency's mission statement, SAP priorities, legislative mandates, and executive orders.

## RESEARCH OBJECTIVES

The objectives of the envisioned research program are the following:

- 1) To assess driving range of commercially available EVs and identify the uses of light-duty fleet vehicles;
- 2) To develop a dataset with ODOT activities and compare commercially available software, data, and models to assist converting ODOT energy needs to EV equivalent metrics.
- 3) To determine Total Cost of Ownership (TOC) of the commercially available EVs that meet the range requirements and intended uses of light-duty ODOT Fleet vehicles; and
- 4) To gather other pertinent information that can aid the decision-making process of purchasing EVs to replace existing vehicles currently part of ODOT's fleet, such as additional cost of insurance, cost and downtime of charging stations, on-hand additional vehicle batteries, etc.

## WORK TASKS, COST ESTIMATE AND DURATION

### **Task 1:** ODOT Fleet Light-Duty Vehicle Needs Analysis

**Duration:** 3 months

**Description:** Interview staff, review reports & document set of performance requirements, including activities, duration, environmental conditions, and other vehicle operation requirements.

### **Task 2:** Execution of Literature Review

**Duration:** 3 months

**Description:** Gather performance data of commercially available EVs and PHEVs, as well as ODOT demands

### **Task 3:** Partnering

**Duration:** 3 months

**Description:** Find stakeholders with similar mandates, including DAS. Coordinate data with other partners. Focus on data-sharing and possible additional funding to still meet ODOT objectives.

### **Task 4:** Development of Vehicle Performance Models

**Duration:** 6 months

**Description:** Research and decide on existing modeling software for EV analysis. Modification of existing computer models to estimate vehicle energy demand under all usage scenarios identified under T1. Validation of tool using performance data gathered under T2.

### **Task 5:** Validation of Automotive Simulation Tool with ODOT's Fleet field data

**Duration:** 12 months

**Description:** This task will investigate practical methods to validate the simulation tool developed in T4 using ODOT's Fleet field data. The practical methods to obtain field data will provide confidence to the energetic calculations performed using the simulation tool developed in T4. This task may show error between actual ODOT work and commercially available performance data for EVs.

### **Task 6:** Performance Parity Analysis and Cost of Ownership Models

**Duration:** 4 months

**Description:** Performance comparison between EV and gas options for ODOT Fleet using tool developed under T4 with info from T5. Modification of existing computer models to estimate TOC for a selection of

electric and gas-engine vehicles that meet ODOT needs identified from prior tasks

**Task 7:** Preparation of Final Report

**Duration:** 2 months

**Description:** Documentation of information gathered in T1- 6. Conclusions and recommendations.

**Key Deliverables:** ODOT needs the modeling and performance data of EVs for vocational work. Guidance on when EVs should/should not be used based on activity and working conditions is needed. This provides confidence with purchases, identifies potential situations where EVs are not suited, and raises awareness.

**Estimated Project Length:** 24 months.

**Estimated Project Budget:** \$194,000

## IMPLEMENTATION

The envisioned research will highlight which ODOT fleet vehicles are suited to be replaced by EVs, as well as work/task descriptions that EVs can accommodate. The final report should also have a detailed summary explaining the impact on battery range for various vocational uses (e.g., a 5k lbs. trailer can be towed 150 miles on a single charge). Perhaps a decision-tree could be developed that offers considerations for when/when not to replace a vehicle with an EV. This research will support light-duty vehicle procurement decisions. Decision makers will be better equipped to purchase EVs with confidence, knowing which vehicles will meet the needs of the unit the vehicle will be assigned to. Cost and performance models developed under this research will be transferred to requesting organization (ODOT Fleet Management) for future usage. The research plan is supported by ODOT Fleet which will allow statewide implementation of the research products.

## POTENTIAL BENEFITS

The primary benefit is the information needed to support light duty vehicle procurement decisions. This information will assist decision makers to place purchase orders with confidence, knowing EVs will meet their intended use and the TOC of its useful life. ODOT will have a much better understanding of where EV vehicles can be replaced that conduct certain activities and where there may be justification for exceptions. These factors are in line with supporting the agency's goal(s) of properly planned and sustainable procurement decisions. If research is not conducted, ill-informed decisions will lead to unsupported and inadequate EVs for the work being conducted.

## PEOPLE

**ODOT champion(s):** Darin Weaver, ODOT Fleet Services Manager

**Problem Statement Contributors:** Amy Regimbal, ODOT EV Program Coordinator; Zechariah Heck, ODOT Sustainability Program Manager; Jon Lazarus, ODOT Research Coordinator

## REFERENCES [Works Cited]

Please see sheet "24-22 TRID\_RIP SUPPLEMENTAL results.docx" for related research.

Brown, G. K. (2020, March 10). Executive Oregon 20-04. *E.O. 20-04 Directing State Agencies to Take Actions To Reduce and Regulate Greenhouse Gas Emissions*. Salem, Oregon, USA. Retrieved March 01, 2023, from [https://www.oregon.gov/gov/eo/eo\\_20-04.pdf](https://www.oregon.gov/gov/eo/eo_20-04.pdf)

CNN Business. (2023, March 02). Ford to restart after F-10 fire issue. *Ford F-150 Lightning electric truck production to restart March 13*. Dearborn, Michigan, USA: CNN Business. Retrieved March 03, 2023, from <https://www.cnn.com/2023/03/02/business/ford-f-150-lightning-production-restart/index.html>

Heck, Z. (2023, February 14). Email Correspondance: EV Info. (J. Lazarus, Interviewer) Retrieved March 09, 2023

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Salem, Oregon, USA. Retrieved March 09, 2023, from <https://www.oregon.gov/energy/energy-oregon/Pages/Transportation.aspx>

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# STAFF REVIEW PAGE

## Literature Check

### TRID&RIP

A review of TRID & RIP databases found no existing research that answers the research question

[Amy email to Jon 2/14/23] I have not found any studies done from other statewide government fleets.

[JML] There were several studies with partial information to answer the research question posed. Several studies contradicted each other in findings. The most relevant study comes from Caltrans and their conversion of fleet to EVs. Although this does not answer the question of ODOT usage, they will have conversion method and data to share. See attached file of listed studies that pertain to this research question.

### Technology & Data assessment

No Identified T&D output

At the end of this project, the implementing unit(s) within ODOT will need to coordinate the adoption of new technology or data in order to realize the full potential of this research.

## Cross-agency stakeholders

- List stakeholders or impacted units

Impacts: Maintenance and Operations. Construction Office. Regions. All staff that travel with light duty vehicles. Possibly some incident response vehicles are classed as light-duty. Construction project managers, inspectors, field personnel, etc, who use a light duty vehicle to travel to job sites. Most ODOT employees whose job does not involve construction equipment will use a state vehicle that classifies as a light duty vehicle.

[Amy email to Jon 2/14/23] I reached out to DAS and asked if they have done any studies. Here is the answer from Brian King: *No, we have not done anything to that level of detail. Just the basics of looking at usage patterns, vehicle type, and range of EV's available. I think it is a great idea though!*

- Identify any issues of concern raised by an ODOT stakeholder. Note expected mitigation

One concern raised during discussions is the “exception” clause under HB 2027. The research should provide guidance on the appropriate use of this this exception clause to help ODOT meet the intent of this legislation.