Exhibit D

Research Project Requirement Template

A Model of EV Adoption and Rank-Based Contributing Factors

Recipient/Grant (Contract) Number: The University of Texas at Austin/Grant # 69A3552344815 and 69A3552348320

Center Name: Center for Understanding Future Travel Behavior and Demand (TBD)

Research Priority: Improving Mobility of People and Goods

Principal Investigator(s): Chandra Bhat

Project Partners: N/A

Research Project Funding: $150,000 (Federal + non-Federal funding)

Project Start and End Date: 6/1/2024 - 5/31/2025

Project Description: The transportation sector is one of the largest contributors to greenhouse gas emissions and accounts for nearly 45% of global oil demand, primarily due to the widespread use of internal combustion engine vehicles (ICEVs). In fact, while the United States has seen overall reductions of greenhouse gas emissions of around 3% since 1990, emissions in the transportation sector have increased by over 20% in the same period. Electric Vehicles (EVs) potentially serve as an important "vehicle" to combat climate change and reduce transport-related greenhouse gas emissions. However, while EV adoption rates have been growing over the past several years, EV costs remain higher than ICEV costs, adoption rates have varied dramatically across different segments of the population, and the share of EVs on the road remains relatively low.

Because EV market shares have so far been very limited, few studies have modeled EV adoption at an individual level using actual EV owners. Instead, much of the literature is focused on two areas: (1) studies of the intention to buy EVs using stated preference surveys, and (2) examinations of aggregate trends in EV ownership levels. But some comparisons between these methods suggest that there is a disconnect between adoption intentions and observed aggregate EV ownership levels. Thus, there is a need for a detailed individual-level examination of EV adoption behavior using the revealed preferences of actual EV owners. Additionally, many studies focus broadly on the issue of EV adoption without considering the differences between major types of EVs, specifically plug-in hybrid electric vehicles (PHEVs) and battery electric vehicles (BEVs). Given that different characteristics of these EV types may appeal to different users, there is a need to understand adoption patterns by EV type.

In the above context, we examine EV adoption behavior using a survey of California households that includes revealed adoption behaviors as well as a ranked set of factors that led to adoption for existing EV owners. The survey was undertaken between November 2022 and January 2023 and collected a total of 1,311 responses from a segment of EV and solar panel owners and a second representative sample of California homeowners. Using the survey, we employ a Generalized Heterogeneous Data Model to jointly model adoption for BEVs and PHEVs along with a rank-based model of the factors that contribute to EV adoption among owners. The use of a joint modeling approach that accommodates unobserved correlations between these outcomes allows for the possibility of "self-selection" effects among EV owners (that is, EV owners may be more likely to prioritize specific reasons for choosing EVs) and allows us to extend the results (of EV adoption and reasons for any such adoption) to the entire population of current EV and non-EV owners, well beyond the population of existing EV owners. We also incorporate four latent constructs representing lifestyle preferences and perceptions of EVs, each of which has been shown to play a role in

EV adoption. The results of this study will have important implications for social and environmental policies promoting EV adoption and will also inform transportation planners in the design of EV charging infrastructure.

US DOT Priorities: This work addresses several components of the RD&T Strategic Plan goals. First, the project investigates factors contributing to EV adoption: "Conduct research to support expanded access and use of electric-powered transportation and supporting infrastructure to reduce emissions" (Page 41). Second, the work addresses equity issues in EV adoption relating to social concerns, economic limitations, and unequal investments in charging infrastructure: "Evaluate the socio-economic equity of the distribution of environmentally sustainable transportation services, infrastructure, and technologies" (Page 42), "Develop data, tools, and research to evaluate and advance the equity and accessibility of transportation systems, projects, jobs, and policies" (Page 33).

The proposed work addresses several of the technology transfer/deployment goals within the RD&T Strategic Plan. This research demonstrates the competing interests involved in vehicle purchase decisions, highlighting the growing benefits of electric vehicles compared with internal combustion engine vehicles that represent critical concerns for potential adopters: "This research helps stakeholders make informed decisions about whether to adopt new technologies, policies, or practices" (Page 64). The research also reveals policy recommendations for promoting EV adoption, leading to improved environmental outcomes: "The Department's technology transfer efforts are critical to translating transportation research into outcomes that make transportation better for people" (Page 65).

Outputs: Expected research outputs include a journal publication and additional conference presentations. These outputs will highlight avenues leading to electric vehicle adoption and existing barriers to adoption, revealing important insights for policymakers. Specifically, the research outputs will provide tangible evidence of barriers to EV adoption and pathways to increase adoption rates and promote more sustainable transportation practices. The study will recognize heterogeneity in the reasons why individuals may (or may not) consider EVs, as well as variations in EV adoption patterns, based on sociodemographic characteristics, local land-use characteristics, individual-level lifestyle preferences, and EV perceptions. The findings from the research can aid in the development of policies and practices that increase awareness of EV benefits, while also informing EV infrastructure design in ways that consider individual/community needs and promote sustainable practices.

Outcomes/Impacts: Expected research outcomes include promoting the adoption of electric vehicles and the increased understanding and awareness of transportation issues regarding electric vehicles. By exploring the behavioral processes that lead existing vehicle owners to adopt electric vehicles, and extending such insights to the entire population, planners and policy makers will be better able to promote the growth of EV technologies and encourage adoption. Insights regarding the impacts of public EV charging infrastructure will provide policy makers pathways to promoting effective charging infrastructure improvements, while those relating to individual-level perceptions of EV technologies can inform the development of effective information campaigns to promote EV adoption.

Expected impacts include insights on the patterns of EV adoption and factors that influence adoption that will be valuable to transportation planners, policymakers, urban planners, and those in the air quality and environmental fields. Specifically, impacts of charging infrastructure on adoption rates will have implications for investments in charging infrastructure. Additionally, understanding the behavioral foundations of EV adoption can lead to large-scale community impacts and environmental benefits if policies are tailored to the needs of potential future adopters. For instance, understanding economic benefits and developing pathways to EV adoption for low-income households can promote equitable transportation outcomes.

Final Research Report: A URL link to the final report will be provided upon completion of the project.