Texas A&M Transportation Institute

PROJECT SUMMARY

Texas Department of Transportation

0-6763: Accounting for Electric Vehicles in Air Quality Conformity

Background

Electric vehicles (EVs) are broadly defined as vehicles that obtain at least a part of the energy required for their propulsion from electricity. This research focused on the three main types of EVs:

- Hybrid electric vehicles.
- Plug-in hybrid electric vehicles.
- Battery electric vehicles.

In recent years, several new and affordable models of these types of vehicles have become available, and the market for EVs continues to grow.

The increased proliferation of EVs is of importance to transportation agencies for a variety of reasons, ranging from revenue implications, to infrastructure and operational support needs. Another aspect is the implications for emissions and energy use. By obtaining part or all of the energy needed for propulsion from electricity, EVs can potentially achieve higher energy efficiencies and result in less exhaust emissions when compared to conventional vehicles powered solely by internal combustion engines. However, there is limited research on the emissions implications of increased EVs in the vehicle fleet. Additionally, in the case of plug-in hybrids and battery electric vehicles, the energy consumption and emissions associated with grid electricity used for charging the vehicle batteries also need to be considered.

The focus of this research was on the implications of EVs in terms of mobile source emissions, i.e., vehicle exhaust emissions. This is a topic of significance to transportation planning agencies, especially those in nonattainment and attainment maintenance areas needing to meet transportation conformity requirements.

The U.S. Environmental Protection Agency's mobile source emissions estimation model, Motor Vehicle Emission Simulator (MOVES), forms the basis for conformity analyses and other mobile source emissions estimations conducted in Texas and much of the United States. The current state of the practice in the use of MOVES does not account for EVs with regard to location-specific driving characteristics, emission rates, and market penetration. However, MOVES provides a platform and has the flexibility to accurately incorporate these aspects into emissions estimations. As the market share of EVs continues to increase, developing methods for accurately incorporating EVs into mobile source emissions estimation will become increasingly important to transportation agencies.

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What the Researchers Did

First, the research team conducted an extensive literature review of EVs covering the state of the EV market, future market penetration scenarios, and implications of EVs for air quality, as well as existing studies, data sources, and tools related to estimation of EV emissions. Based on this information, researchers developed a set of Texas-specific market penetration scenarios using a consumer choice model that took into account energy prices and government policy forecasting.

The research team also conducted an extensive vehicle activity data collection exercise from a sample of EVs in major Texas metropolitan areas. Researchers used these data to develop representative Texas-specific EV drive schedules. In-use emissions testing of EVs was conducted using portable emissions measurement systems to obtain operating mode-based emissions rates, which were combined with the drive schedules to generate distance-based emissions rates for each type of EV by speed bin and road class. Finally, the research team incorporated these emissions rates along with EV market penetration scenarios into a MOVES-based emissions analysis as part of a pilot application for Harris County, Texas.

What They Found

The researchers successfully developed a framework to incorporate EVs into mobile source emissions estimations, specifically for transportation conformity-type analyses. The framework integrates region-specific EV driving characteristics, emissions rates, and market penetrations into a MOVES-based emissions inventory analysis. The intent of the framework was to be flexible and practical, and enable Texas transportation agencies to accurately estimate EVs' impacts on mobile source emissions. The application of the framework is not limited to Texas and could be extended to other geographic regions with the use of available data or through local data collection. The pilot application results demonstrated successful use of the framework and also showed that inclusion of EVs in the framework resulted in differences in emissions estimates specifically for future years.

What This Means

The research team developed and demonstrated an analytical framework that can be used to account for EVs in emissions analyses. Additionally, a wealth of EV-specific data (including drive schedules and emissions rates) were collected in Texas. This research addresses an emerging area of concern to transportation planning agencies—understanding the emissions implications of EVs and accounting for EVs in emissions estimations, including transportation conformity analyses. The findings from this project allow Texas' transportation practitioners to be well equipped to address these issues in the future.

For More Information

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