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Mexico Electrified: Updating Mass Transit Vehicles to Help Meet Paris Climate Goals

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Introduction

As one of the 2016 signatories of the Paris Agreement, Mexico has international and domestic commitments to reduce greenhouse gas (GHG) emissions and help keep global temperature increases below the 1.5°C threshold. The transportation sector in Mexico is one of its largest contributors of GHGs. Therefore, to meet its emission reduction targets, Mexico will need to transition towards an electrified system of transport.

In addition to supporting emissions reductions goals, transitioning the public transport to an electrified system has the potential to provide mobility that is more efficient, equitable, and safer. Furthermore, electrifying the transit system will have a dramatic positive impact on local air quality, noise, and cost of operation.

Researchers at UC Davis conducted a preliminary analysis on the Passenger Transportation Network (Red de Transporte de Pasajeros or RTP), a municipal bus network in Mexico City, to identify the most suitable modules for electrification, with an eye toward developing a tool to optimize the deployment of battery electric buses at RTP and other transit agencies around Mexico.

Mexico City (CDMX) is the most populated, largest, and most influential city in the nation. It hosts one of the largest and most complex public transportation systems in Latin America. Public buses and micro-buses provide the main mode of transportation in the city.

However, the majority of CDMX's passenger transport vehicles are powered by combustible fuel with the two primary fuels being diesel and gasoline. Additionally, buses operating in CDMX can drastically range in their model years, with brand new buses operating alongside buses from the 1970s. The use of these types of vehicles contributes significantly to the adverse environmental conditions and increases in GHGs emissions.

Key Findings

Mexico City's RTP has the potential for immediate adoption of an electric fleet. Based on the model exercise conducted, researchers identified several RTP routes that have a high potential for success in electrification using opportunity charging.

Preliminary analysis of RTP found that Modules 1 (western branch) and 6 (northern branch) contained the highest density of routes that had characteristics that made them well-suited for electrification, particularly, their short length and high daily trip count, as shown in Figure 1. These Modules may have additional success if costs can be lowered by using vehicles with smaller battery packs and fewer overall chargers, both of which can be accomplished

with a robust program of en-route opportunity charging on these routes.

Preliminary analysis of the effects of electrifying these routes indicate a combined savings, depending on certain assumptions, of 1000 to 5000 gallons of diesel fuel per operational day. Based on fuel costs and electricity costs in CDMX, this represents a savings in fuel costs of almost 6,000 (USD) per day on these two Modules alone. Given the average market prices of electric buses, the savings on diesel alone can unlock enough fiscal resources to purchase a new bus every 3-4 months. What's more, if costs of buses or electricity can be decreased, either through purchasing assistance or deals with providers, this time can be reduced significantly. The deployment of a pilot project focused on electrifying these routes could provide further insights for RTP to understand operational challenges and tradeoffs of distinct charging strategies.

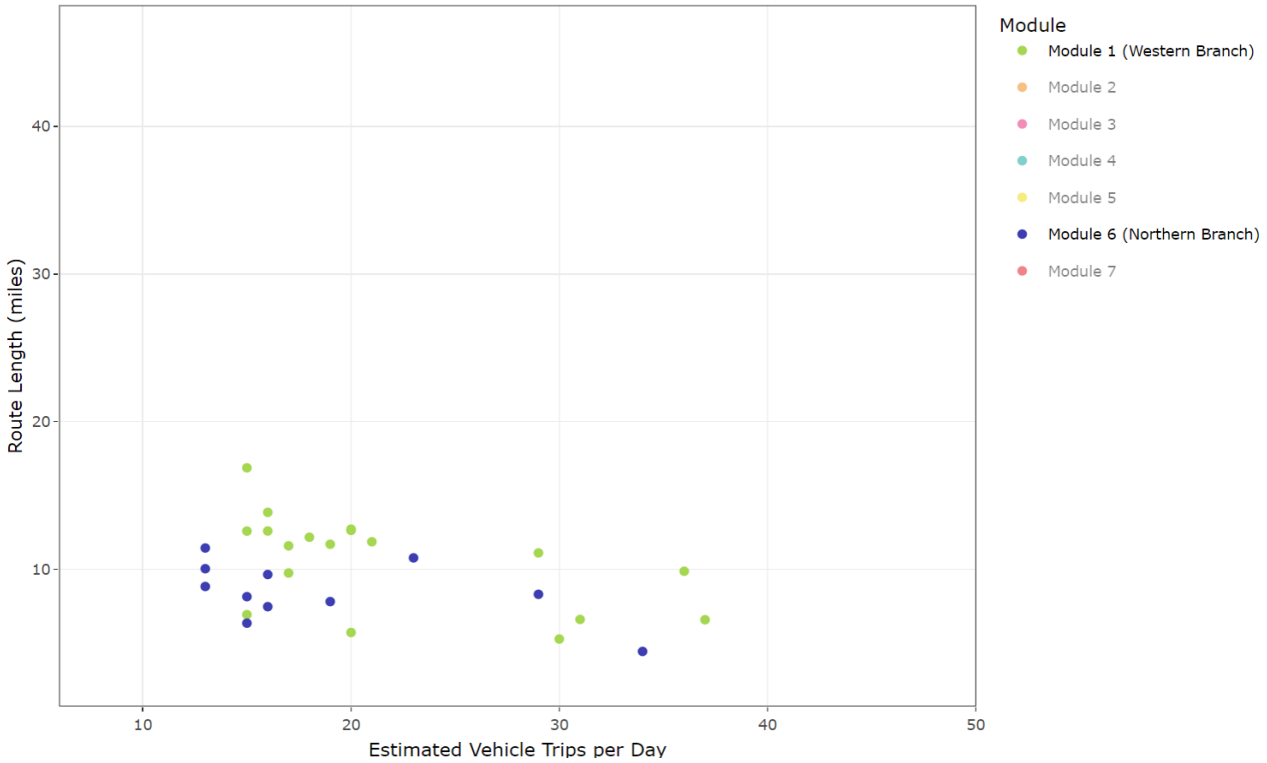

Figure 1: *A scatter plot of daily trip count versus route length for Modules 1 (western branch) and 6 (northern branch). Routes lower and further to the right on this chart have a higher affinity for electrification, especially in conjunction with en-route opportunity charging.*

Data collection and data-sharing will facilitate transit electrification. Researchers identified data gaps that impact the development of instruments to support transit electrification. While these data sets may currently exist for transit agencies in Mexico, they are not readily available or consistent across agencies. It will be necessary to develop reliable data feeds (i.e., General Transit Feed Specification) that can provide the most updated data to be analyzed. Once collected, these types of datasets should be made available to researchers and other stakeholders. The availability of these data sources will produce better results and in turn, provide the knowledge base to inform important decisions about transit electrification. The tools supported by UC Davis required existing data with planners to support a low-cost transition.

Political support from the highest levels of government is critical for transit electrification. Mexico's current administration at the federal level has favored energy security. Policies have increased the production and expansion of fossil fuel operations while private investments in renewable energy have been limited. Sources of climate mitigation funding have been repurposed, while critical institutions on climate policy have been diluted or dismantled.

Since 2018, the Secretariat of the Environment and Natural Resources (SEMARNAT) has been developing a National Strategy for Electric Mobility. This document is proposed to be the road map to set Mexico on a path towards electrification, however it remains as an unpublished internal document. It has been widely reported that the National Strategy includes zero emission vehicle (ZEV) adoption targets, coordinated regional efforts to streamline ZEV transit service, and an aggressive plan to deploy ZEV charging infrastructure.

While these are ambitious efforts, the SEMARNAT is one of the agencies with diluted political strength and support. If the current political trends continue, it is unlikely that the path toward electrification in the transportation sector can gain significant momentum. Mexico's international and domestic climate commitments depend on a shift in the current practices and policies.

Figure 2: *Electric Bus operated by San Joaquin Rapid Transit in Stockton, California (left). Bus depot with electric fleet in Davis, CA (right).*

Next Steps and Future Research

An electrified transit system, specifically in major urban centers, is critical for Mexico to reach its emission reduction goals. The research presented offers tools that can help gain immediate success in electrifying parts of the system. However, gaps in the data make it difficult to suggest any major transition to large sections of the existing transit network.

The next phase of this will focus on working closely with stakeholders and transit providers to collect, compile, and share data. Furthermore, the research team plans to adapt the model into a version that can be used generally by transit agencies across Mexico. When used in conjunction with GTFS data, the model will produce results that can aid transit agencies in long-term planning to deploy an electrified transit system, decide on equipment investments and technology type, and reduce the transition cost.

Future work will also include workshops for institutional knowledge-sharing between domestic transit agencies that currently operate an electric fleet and Mexican agencies that plan to adopt them. A major focus of this effort is to ensure that the provider and receptor of information are those involved in the day-to-day operations (i.e., mechanics, drivers) rather than those further away from these activities. Ultimately, the goal of this knowledge sharing is to avoid previous missteps and learn best practices for the successful adoption of an electric fleet.

This policy brief is drawn from a longer report entitled "Exploring Tools for Maximizing the Potential for Electrified Transit Buses in Mexico: Preliminary Research Report" available at https://escholarship.org/uc/item/5nv441q2.