

## Problem B: Charging Ahead with E-buses



The proliferation of **electronic buses (e-buses)** in cities across the globe represents a significant stride toward sustainable urban transport. With the mounting concerns over air pollution and climate change, many cities have been prompted to reconsider their reliance on traditional diesel buses. According to a recent report by Bloomberg New Energy Finance<sup>[1]</sup>, e-buses are set to dominate the public transit sector, becoming the majority of all buses on the road globally by 2032. China has been particularly noteworthy in this transition, as it is home to most of the world's e-buses, driven in large part by government policies that prioritize electric vehicles and stringent emission standards. Cities throughout the world (e.g., Bogota, Colombia, New York, USA, and Berlin, Germany) are also making concerted efforts to incorporate e-buses into their fleets, albeit at a more gradual pace.

E-buses aren't only environmentally appealing but are also anticipated to be cost-effective in the long run due to falling battery prices and lower operational expenses. Governmental incentives, such as the \$1.7 billion allocation from the 2023 Bipartisan Infrastructure Law for e-bus projects in the U.S.<sup>[2]</sup>, further bolster e-bus adoption. However, challenges include high initial costs, charging infrastructure development, lengthy charging times, and potential range limitations.

1. Construct a model to aid cities in understanding the ecological consequences of transitioning to an all-electric bus fleet.

Identify a **metropolitan area** with a population of (at least) 500,000 people that does not currently have a fully electric bus fleet. Apply your model to your chosen location.

2. Money matters. Construct a model that focuses on the financial implications associated

with a conversion to e-buses. Your model should factor in potential external funding covering up to 50% of the transition costs.

Apply your financial model to the same metropolitan area you used in the previous question.

3. Transportation officials in metropolitan areas are exploring approaches in which they gradually change their fleet from combustion engines buses to electric. Assuming the goal is to have a fully electric fleet no later than 2033, utilize your previously developed models to craft a 10-year roadmap that urban transport authorities can leverage to plan their e-bus fleet updates.

Apply your models (or new model) to the same metropolitan area you used in the previous question and also apply it to two additional metropolitan areas of your choosing.

4. Write a one-page letter to the transportation officials of one of your chosen metropolitan areas in which you detail your recommendation for their transition to e-buses.

Your PDF solution of no more than 25 total pages should include:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- One-page letter to the transportation officials.
- References list.

**Note:** There is no specific required minimum page length for a complete MCM submission. You may use up to 25 total pages for all your solution work and any additional information you want to include (for example: drawings, diagrams, calculations, tables). Partial solutions are accepted.

### **Glossary**

An **Electric Bus (e-bus)** is any bus whose propulsion and accessory systems are powered exclusively by a zero-emissions electricity source.

**Metropolitan Area:** a core area containing a large population nucleus, together with adjacent communities that have a high degree of economic and social integration with that core.

### **References**

[1] <https://about.bnef.com/electric-vehicle-outlook/>

[2] <https://www.transit.dot.gov/about/news/biden-harris-administration-announces-nearly-17-billion-help-put-better-cleaner-buses>