

TO: Carbon-Free Mobility Team, Rocky Mountain Institute

FROM: Michele Zemplyni, Aspiring Associate

SUBJECT: Electric Bus Transition Kick-off Meeting

DATE: December 14, 2020

### Summary

Ahead of our meeting with County Transit regarding transitioning their fleet to electric buses, I outlined below the key topics and associated questions that will drive our agenda. There are a large number of factors that will determine whether or not procuring e-buses is financially feasible for the agency; once we have a deep understanding of (1) the agency's goals, (2) their current operations, (3) the stakeholders and partners involved, and (4) the agency's financing options and preferences, we will be able to recommend e-bus configurations and financing structures that meet their needs and warrant further analysis. We can then assist the agency with a thorough total cost of ownership analysis that uses a simulation approach to generate sensitivity analyses. This analysis strategy will enable us to evaluate which of the procurement options is most likely to yield the greatest cost savings.

### Key Topics for Discussion

#### **1. Understanding agency goals**

- a. In addition to your primary goal of saving money, do you have other priorities or planned changes to transit services? (e.g. building new lines, increasing the frequency of bus service, lowering emissions along routes in low-income communities)
- b. Over what time frame will you be evaluating potential investments?
- c. Is there a specific savings target you are aiming to reach?

#### **2. Overview of current operations**

- a. How old is your current fleet of buses?
- b. How long are the transit routes and how often do buses run?
- c. What are the annual fuel and maintenance costs for the diesel buses?
- d. How long do the buses spend at the depot and terminals?
- e. Does the transit agency own the depot, and would its layout accommodate new charging infrastructure?
- f. Are the bus routes relatively flat or are there large hills?
- g. What are typical passenger loads?
- h. How often is air conditioning used on the buses?
- i. Do you have an internal carbon fee that has factored into prior agency decision-making?

#### **3. Identifying potential partners and stakeholders**

- a. Are other departments considering electrifying their fleets (e.g. emergency services, school district, waste management)?
- b. Have you discussed joint procurement with other transit agencies?
- c. Have you, the local utility, and grid operator discussed options for time-of-use electricity rates, bidirectional charging, and impacts on the grid due to increased load?
- d. Have you discussed the co-benefits of transitioning to e-buses with city officials in order to get buy-in and expand the agency's budget? (e.g. public health benefits of improving air quality, noise reduction, and the subsequent increase in property values and property taxes along transit routes resulting from the aforementioned benefits)

#### 4. Financing options and preferences

- a. What incentives, grants, and funds can the county apply towards an e-bus purchase ? (e.g. Volkswagen Settlement Fund, Low-No Emissions Vehicle Deployment Program)
- b. Have you explored the Pay-As-You-Save<sup>1</sup> clean energy financing option?
- c. Do you have any preference with regard to whether the agency owns or leases the buses and/or batteries?
- d. Do you prefer to purchase buses from domestic manufacturers?

#### Evaluating options: total cost of ownership analysis

In order to compare e-bus and diesel bus procurements, we will consider not only the upfront costs, but also the various lifetime costs that contribute to the total cost of operating and maintaining a bus. In order to account for the time value of money and the different cash flows among the various procurement options, we will compare the total net present value (NPV) cost of each procurement.

We will need to estimate several components of the total cost of ownership for the e-bus procurements. Depending on the procurement details, these components may include the cost of buses and batteries, charging (based on forecasted electricity rates), charging infrastructure, maintenance, repairs, bus downtime, driver training, insurance, financing, as well as the residual value of the bus at the end of the timeframe of interest (e.g. the 12-year lifetime of the bus). Data from the Energy Information Administration and Environmental Protection Agency along with discussions with other transit agencies that have already electrified their fleets will be invaluable resources for forming reasonable model assumptions. For the diesel bus procurement, the county's historical transit data and finances will be useful guides.

In order to account for the uncertainty in our model assumptions for inputs such as the diesel price and the cost of batteries, we should perform sensitivity analyses. As a first cut for a sensitivity analysis, we could supply a range of values for an input, such as \$2.40-3.00 per gallon for the diesel price, and use the model to calculate the total NPV cost for each diesel price within that range. Atlas Public Policy's comprehensive Fleet Procurement Analysis Tool<sup>2</sup> provides sensitivity analyses for various inputs using this strategy.

We may be able to generate more informative sensitivity analyses, however, by describing the possible diesel prices not just as a range, but as a probability distribution (e.g. a normal distribution centered at \$2.60). We could then calculate the NPV cost one thousand times, each time randomly selecting a new value from the diesel price probability distribution to use as an input for the model. After performing these simulations we would then chart a histogram of the one thousand NPV costs, allowing us to visualize not just the range of possible NPV costs for an e-bus procurement, but their likelihoods as well. The benefit of performing sensitivity analyses using this simulation strategy is that we can answer the question, "How likely is it that procurement A will yield a lower total NPV cost than procurement B?" Our ability to give an informed answer to that question, while being transparent about the assumptions and limitations of our modeling approach, will give the transit agency more confidence in our analysis and in their decision to electrify their fleet.

<sup>1</sup>Rebecca Strauss (2019). "[Electric Buses and Clean Energy Financing: How Transit Authorities Can Leverage State and Federal Funds to Buy More Zero-Emission Buses.](#)"

<sup>2</sup> Nick Nigro and Phillip Quebe (2020). [Fleet Procurement Analysis Tool.](#)