



August 17, 2018

**VIA ELECTRONIC MAIL**

Tennessee Department of Environment and Conservation  
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Nashville, TN 37243  
Email: TDEC.OEP@tn.gov

**RE: Comments of the Sierra Club and Partners Regarding Tennessee's Proposed Beneficiary Mitigation Plan Pursuant to the Volkswagen Environmental Mitigation Trust Agreement**

On behalf of the Sierra Club and its Chapter and nearly 8,700 members in Tennessee, Southern Alliance for Clean Energy, Statewide Organizing for Community eMpowerment, Tennessee Conservation Voters, Tennessee Interfaith Power & Light, and Tennessee State Conference of the National Association for the Advancement of Colored People (collectively, the Commenters), we respectfully submit these comments regarding Tennessee's Proposed Beneficiary Mitigation Plan (the Plan).<sup>1</sup> As explained below, the Commenters strongly support Tennessee's prioritization of light-duty electric vehicle (EV) charging infrastructure and dedication of 60 percent of the funds to transit buses and school buses. However, the Commenters urge Tennessee to take into account the financial and public health benefits of full electrification of public transit buses in cities across Tennessee over other, dirtier alternatives, and to prioritize the advancement of environmental justice goals when drafting its final plan. To those ends, the Commenters recommend that Tennessee dedicate an even larger percentage of the funds to electrify public transit and school buses due to the lifetime savings of all-electric buses and the improvements to air quality in the most polluted and vulnerable areas.

**I. Electrification of Transit and School Buses will Maximize Benefits to the State of Tennessee**

The economics favor widespread investment in zero emission transit buses and their supporting infrastructure. Electrification of Tennessee's transportation sector keeps money in state, saves money through lower electricity rates, drastically reduces NOx, smog, and greenhouse gas (GHG) levels to protect health and environmental justice communities, and likewise reduces GHG emissions throughout the state.

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<sup>1</sup> Prior to submitting these comments, the Sierra Club and partner organizations submitted comments on January 16, 2018 regarding the use of the Volkswagen (VW) Partial Consent Decree Environmental Mitigation Trust Funds. *Available at* <https://content.sierraclub.org/evguide/sites/content.sierraclub.org/evguide/files/Sierra%20Club%20and%20Partners%20Comments%20RE%20VW%20Draft%20Beneficiary%20Mitigation%20Plan.pdf?scv=1516307792198>.

The lifetime cost of an electric bus is significantly lower than that of a new diesel or alternative fuel bus, though the upfront cost is higher. The all-in cost—that is, the upfront cost of the bus purchase, fuel costs, and maintenance costs—for an electric bus is \$1,000,000, as compared to \$1,400,000 for diesel and compressed natural gas (CNG) buses.<sup>2</sup> Moreover, as electric bus manufacturing scales up, and as battery costs—the most expensive part of an EV—plummet over time, electric bus prices will fall rapidly as well.

### 1. *Up-front Costs*

Government estimates of electric bus prices sharply decline as advances in battery manufacturing and increased demand drive down costs. By 2025—within the 10-year timeframe of the VW Environmental Mitigation Trust grant program—an electric bus is expected to cost \$480,000, equal to or less than the cost of a new diesel vehicle.<sup>3</sup> Much of this decrease is attributable to projected reductions in battery costs. A California Air Resources Board-conducted literature review concluded that studies consistently place the cost of batteries below \$500/kWh by 2020, and approaching \$200/kWh by 2030.<sup>4</sup> These estimates are already outdated and clearly understate the rate of reductions in battery costs. GM announced that, even in 2016, it was procuring batteries for its Bolt EV for \$145/kWh.<sup>5</sup> But, as discussed in more detail below, even without future reductions in costs, electric buses, with their far lower fuel, operating, and maintenance costs, exhibit lower lifetime costs than diesel and CNG buses.

### 2. *Total Cost of Ownership*

Despite their greater purchase price, current analysis using Argonne National Laboratory's AFLEET Model demonstrates that electric buses have a **total cost of ownership 19% lower than new diesel buses**. Maintenance costs for electric buses are between 70% and 79% lower than for CNG and new diesel buses respectively, contributing to significant cost savings over the lifetime of a bus. Based on currently reported data, **each all-electric bus will save Tennessee's transit agencies over \$250,000** as compared to a new diesel bus purchase.

As this electric bus technology continues to develop, all-electric bus up-front capital costs will continue to drop, whereas CNG and diesel bus capital cost trends are continually increasing.<sup>6</sup> This is the case even when compared to hybrid diesel-electric buses: a lifecycle analysis using data compiled by the California Air Resources Board in 2016 shows that hybrid

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<sup>2</sup> *The Business Case for the Proterra Electric Bus*, Aug. 3, 2015, <http://ecomento.com/2015/08/03/business-caseproterra-electric-bus/>.

<sup>3</sup> Air Resources Board Cost Model, slide 10 (all values in 2016 dollars).

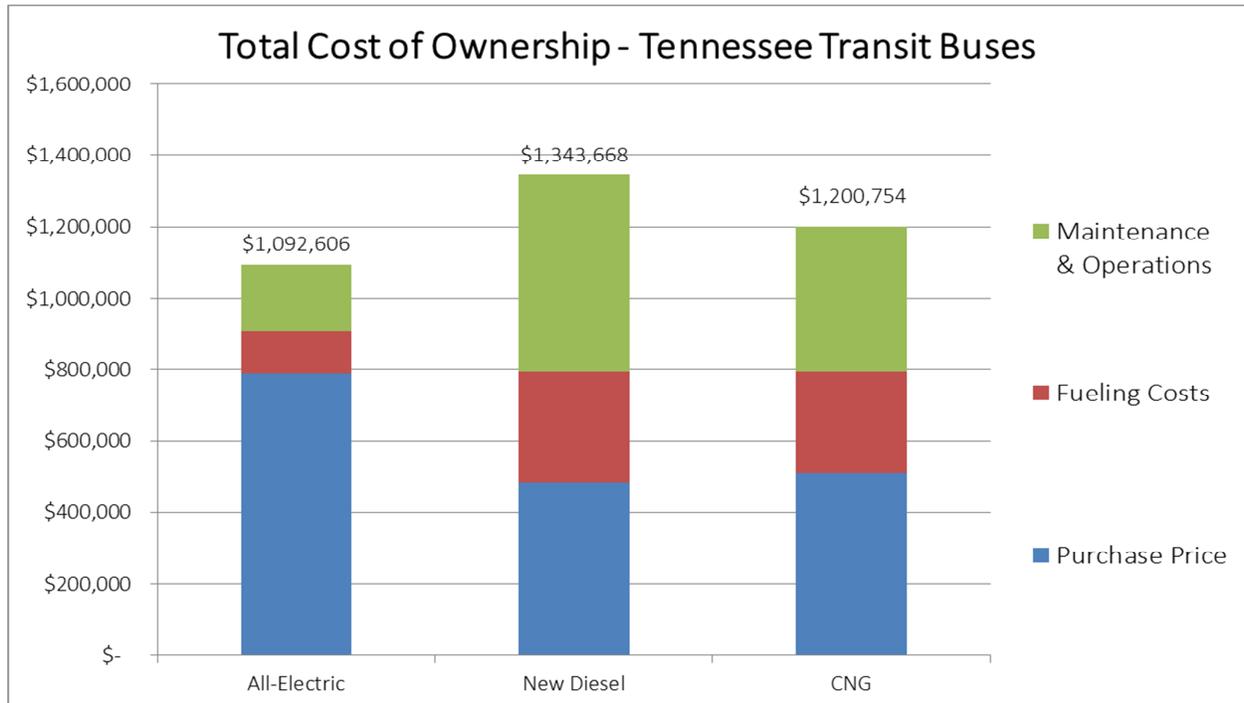
<sup>4</sup> *Id.* slide 11.

<sup>5</sup> Jay Cole, *GM: Chevrolet Bolt Arrives in 2016, \$145/kWh Cell Cost, Volt Margin Improves \$3,500*, <http://insideevs.com/gm-chevrolet-bolt-for-2016-145kwh-cell-cost-volt-margin-improves-3500/>.

<sup>6</sup> California Air Resources Board. (2016) *Total Cost of Ownership to Advance Clean Transit*. Presentation Prepared for the 4th Meeting of the Advanced Clean Transit Working Group. [https://www.arb.ca.gov/msprog/bus/4thactwgmtng\\_costs.pdf](https://www.arb.ca.gov/msprog/bus/4thactwgmtng_costs.pdf).

diesel-electric buses have a total cost of ownership of \$1,909,847, over \$700,000 greater than an electric bus.

**Figure 1**



*Source: Argonne National Laboratory’s AFLEET Model (2017); fuel and electricity costs adjusted for Davidson, County, TN*

The total cost of ownership is derived from Argonne National Laboratory’s AFLEET Model (2017). Fuel prices are adjusted for the Nashville, Tennessee region. Model inputs are populated using averages of fuel economy and maintenance costs reported directly by transit agencies from the years 2014 to 2017.

### 3. Maintenance and Fuel Costs

Maintenance and fueling expenses typically account for a significant portion of the lifetime costs of a transit bus. An investment in zero-emission vehicles will dramatically reduce this figure. As highlighted above, all-electric bus maintenance and repair costs are 79 and 70% lower than the maintenance and repair costs for new diesel and CNG respectively.<sup>7</sup> Furthermore, all-electric buses are fueled by regionally generated electricity, which has demonstrated far more reliable pricing as compared to diesel oil and natural gas.<sup>8</sup>

<sup>7</sup> Metrics derived from Argonne National Laboratory’s AFLEET Model (2017) and ZEB transit studies.

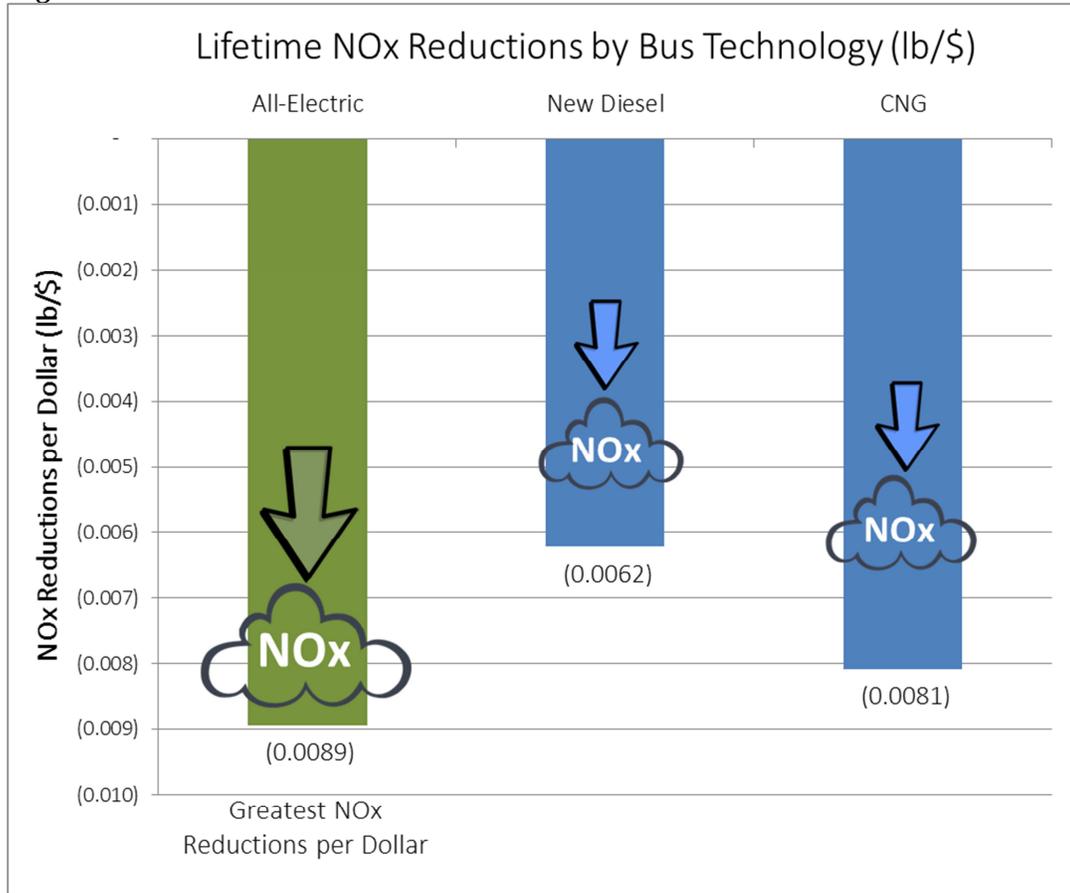
<sup>8</sup> <https://www.afdc.energy.gov/fuels/prices.html>.

	Fuel Economy (MPGDE)	Maintenance & Repair (\$/mi)
<b>Electric</b>	<b>19.44</b>	<b>\$0.17</b>
Diesel	4.16	\$0.80
CNG	3.87	\$0.56

4. *NOx Reductions (lb/\$)*

Specific to the Volkswagen Settlement, agencies are instructed to demonstrate their anticipated NOx reductions as a result of their state’s environmental mitigation transportation investments. Many agencies are in search of the investment that results in the greatest NOx lb/\$ ratio, but they are only considering the upfront purchase costs in these calculations. If the total lifetime costs are considered, the **bus technology with the greatest NOx lb/\$ ratio is a zero-emission bus.**

**Figure 2**



In addition to transit buses, Tennessee’s plan also prioritizes school buses, which are ideal fits for electrification. Electric buses are already in use by a number of municipalities throughout the country.<sup>9</sup> Buses typically operate two shifts each day, once in the morning and again in the afternoon. Down time between shifts allows buses to fully recharge. In King County, California, two electric school buses were estimated to save roughly 16 gallons of fuel per bus per day. This amounted to an annual fuel saving of over \$11,000 per bus.<sup>10</sup> In Tennessee, with its relatively low electricity prices, the savings would be even greater.

<sup>9</sup> See, e.g., James Ayre, *Massachusetts Puts \$1.4 Million into Electric School Bus Pilot Program*, Aug. 16, 2016, <https://cleantechnica.com/2016/08/16/massachusetts-puts-1-4-million-electric-school-bus-pilot-project/>; Nicole Schlosser, *Can Electric School Buses Go the Distance?*, May 23, 2016, <http://www.schoolbusfleet.com/article/713421/can-electric-school-buses-go-the-distance> (providing an overview of state and local pilot projects); Larry Hall, *Tech: The Yellow School Bus Is Going All Electric*, Clean Fleet Report, Mar. 26, 2016, <http://www.cleanfleetreport.com/tech-yellow-school-bus-going-electric/>.

<sup>10</sup> Larry Hall, *Tech: The Yellow School Bus Is Going All Electric*, Clean Fleet Report, Mar. 26, 2016, <http://www.cleanfleetreport.com/tech-yellow-school-bus-going-electric/>.

## 5. Recommendations

The Plan proposes dedicating 10 percent of the funds to class 8 local freight trucks and port drayage trucks as well as 15 percent to class 4-7 local freight trucks. While the Commenters support the use of funds for class 4-7 trucks such as garbage trucks, the remaining 10 percent of funds should be diverted back to the transit and school bus sector. Class 8 local freight trucks and port drayage trucks do not provide the same economic and environmental justice benefits to Tennessee. Neighboring state plans are taking this into account. Georgia, for example, is allocating 100 percent of its VW mitigation trust funds to zero-emission electric transit buses in and around Atlanta.<sup>11</sup>

As previously mentioned in the Sierra Club and Partners' Comments from January 16, 2018, diesel buses also disproportionately impact disadvantaged communities, meaning that these communities stand to benefit the most from investments in electrification. Major cities like Nashville, Memphis, Knoxville, and Chattanooga feel the worst impacts of NOx pollution. These cities also have some of the largest environmental justice communities in Tennessee. A census of near-roadway populations found that around 20 percent of the U.S. population lives near a high volume road, and minorities and low-income households are drastically over-represented in this population.<sup>12</sup> By adding all-electric transit buses to routes that serve environmental justice communities, and prioritizing environmental justice and equity, Tennessee has the opportunity to improve the health of these communities and other vulnerable populations across the state.

## II. EVSE and Environmental Justice Concerns in Tennessee

As noted above, Tennessee's plan to dedicate 15 percent of the funds to EV charging infrastructure is a strategic and commendable use of these funds. The Commenters urge Tennessee to keep in mind, however, that investments in EV charging infrastructure should be made in the following types of locations: highways, workplaces, and disadvantaged communities. Low-income communities and communities of color are a natural but largely untapped market for EVs. Ensuring that workplaces and disadvantaged communities are provided charging infrastructure will help promote more equitable access to electrified transportation while also improving air quality in overburdened communities.

Overall, this is a thoughtful plan that considers the environmental and health benefits of the VW Settlement funds, but the Commenters stress the importance of electrifying the transit

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<sup>11</sup> See *Beneficiary Mitigation Plan for the State of Georgia*, Office of Planning and Budget (Jan. 30, 2018) [https://opb.georgia.gov/sites/opb.georgia.gov/files/related\\_files/site\\_page/Georgia%20Mitigation%20Plan%20%28Final%29.pdf](https://opb.georgia.gov/sites/opb.georgia.gov/files/related_files/site_page/Georgia%20Mitigation%20Plan%20%28Final%29.pdf).

<sup>12</sup> Gregory M. Rowangould, *A Census of the US Near-Roadway Population: Public Health and Environmental Justice Considerations* (2013), <http://www.sciencedirect.com/science/article/pii/S1361920913001107>.

bus sector, especially in Tennessee's major cities, to advance state goals of improving air quality generally and in environmental justice communities.

Respectfully Submitted,

/s/

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