Air Quality Effects from the Proposed Bus Hub at Bowie High School, El Paso, Texas

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The National Center for Sustainable Transportation Undergraduate Fellowship Report

Jenny Callan, University of California, Davis
Mentor: Professor Deb Niemeier, Dept of Civil and Environmental Engineering, University of California, Davis
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A National Center for Sustainable Transportation Research Report

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Jenny Callan, Department of Civil Engineering, University of California, Davis
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Introduction

Bowie High School is located in the Chamizal Neighborhood in El Paso, Texas. This neighborhood shares a border with Mexico and is located adjacent to the Bridge of Americas. The Bridge of Americas links El Paso with the Ciudad Juarez and is a heavily traveled freeway between Mexico and the United States. The Chamizal neighborhood is a low-income, minority neighborhood that has experienced a history of discrimination. Within the community, residents experience high levels of air pollution and traffic that harm students’ and residents’ health (1).

El Paso Independent School District (EIPSD) plans to relocate a bus hub to Bowie High School. The bus hub is subject to relocation because EIPSD’s lease on its current bus hub is ending. The current lease cannot be renewed because the city of El Paso wants its land back (1). As a result, EIPSD must move 124 busses from its current hub to elsewhere within El Paso. Within the city, EIPSD has determined three suitable locations. As seen by google maps in Figure 1, the three locations for the busses are the Northeast Annex, the West Annex, and Bowie High School. EIPSD plans to move 112 busses to Bowie High School, 0 busses to the North East, and 12 busses to the West (1). With the majority of busses located at Bowie High School, EIPSD plans to make Bowie High School the central operations hub. The construction of the bus hub will replace Bowie High School’s current baseball field with a large bus storage area, maintenance, and other service facilities for other busses.

Figure 1: Locations of Suitable Bus Hubs (in Google Maps)
Figure 2. General Layout of Bowie High School Bus Hub

Over the last few years, Chamizal residents have heard plans about the construction of the main bus hub at Bowie High School. Upset with the proposed plan, many Chamizal residents have lead protests outside Bowie. On May 2nd, 2018 the community group, Familias Unidas del Chamizal, wrote a letter to EPISD expressing their concerns of the bus hub being constructed at Bowie High School. Seeing that the proposed bus hub as a potential health hazard, Familias Unidas del Chamizal wrote, “Bowie High School is located in an area that already suffers some of the worst air quality in all of El Paso. Bringing more buses into this neighborhood would further harm air quality, thereby threatening the wellbeing not only of EPISD students and faculty, but also the many area residents” (2).

In response, EPISD stated that “the District is committed to using propane-powered busses. Compared with diesel and gasoline, propane vehicles can produce lower amounts of some harmful air pollutants and greenhouse gases. This would include reduction of particulate emissions”(3). El Paso School District plans on replacing its whole fleet of busses to propane by 2022. This will be 3 years after the proposed bus hub is constructed at Bowie High School. With this switch, EPISD hopes to “minimize any adverse effects, if any, to the Bowie Campus” (3).

Not viewing the solutions provided by EPISD as sufficient enough to reduce the added emissions, Familias Unidas del Chamizal and Texas RioGrande Legal Aid Group submitted a formal complaint regarding EPISD’s plans to relocate a bus hub to Bowie High School (1).
Objectives

The purpose of this report is to provide evidence for Texas RioGrande Legal Aid Group’s case against the movement of the proposed bus hub to Bowie High School. This study will first examine any legal injustices that may be present with the proposed move. We will then analyze EPISD’s statements of propane busses reducing emissions. Specifically, this report will examine the comparison of the pollutant load of diesel and propane powered busses. We will be looking at the pollutant load if the whole fleet of busses converted to propane as well as their added emissions during idling.

Methods

In examining any legal injustices, we will first gather information from the Department of Justice and EPA. We will use this information to if there are any laws that EPISD could be breaking by moving 124 busses to Bowie High School. To generate the emissions of propane and diesel powered busses, we will use the Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool. The AFLEET tool, is an excel sheet that estimates petroleum use, greenhouse gas emissions, air pollutant emissions, and costs of ownership for vehicles (4). Shown below in Figure 3, is a screenshot of the inputs of the AFLEET tool.

![Figure 3: Screenshot of the AFLEET tool](image-url)

The AFLEET tool was a tool funded by the Department of Energy Clean Cities program and co-sponsored by the EPA. The tool was originally created to estimate criteria air pollutant reductions achieved by alternative-fueled vehicles in 1998. The AFLEET tool has four options.
within the excel sheet. These are: Simple Payback Calculator, Total Cost of Ownership, Fleet Footprint Calculator, and Idle Reduction (IR) Calculator. All four of these tools take user inputs such as primary vehicle location, vehicle type, vehicle fuel type, number of vehicles, annual vehicle mileage, fuel economy, vehicle purchase price, public or private fuel station pricing, and fuel and diesel emission fluid (4).

Within the tool, we will use the “Fleet Footprint Calculator”. We will use this tool to input specifications of the diesel and propane vehicles used in El Paso. The input specifications used are vehicle type, age, year, and annual mileage. This will allow us to generate and compare the expected pollutant load of propane and diesel busses. Shown below in Figure 4 and 5, are example inputs and outputs from the Fleet Footprint Calculator.

![Figure 4: Example of inputs of AFLEET tool](image-url)
Figure 5: Example of outputs of AFLEET tool

Injustices:

The three different injustices we will be examining are; Title VI Civil Rights Act of 1964, EPA’s School Sitting Guidelines, and the National Ambient Air Quality Standards. To do this, we will be using information from the Department of Justice and the EPA.

**Title VI Civil Rights Act of 1964**

Title VI Civil Rights Act of 1964 “prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance” (1). Title VI regulations state “In determining the site or location of facilities, a recipient or applicant may not make selections with the purpose or effect of excluding individuals from, denying them the benefits of, or subjecting them to discrimination under any program” (1).

The Chamizal Neighborhood consists of a 97.6% Hispanic, 1.5% Black, and 0.9% White population (1). In addition, 50% of the students were English Language Learners and 82.2% were considered economically disadvantaged (1). Bowie High School and a large part of the Chamizal neighborhood have worse health outcomes compared to the city as a whole in several pertinent categories. These categories include: Adults Reporting to Have Asthma, Adults Ever Diagnosed with Chronic Obstructive Pulmonary Disease, Adults Ever Diagnosed with High Blood Pressure (Hypertension) and Adults Reporting Seven or More Days of Poor Physical Health in the Past 30 Days (1). In addition, Bowie High School has experienced history of standing up to discrimination. In fact, a court found that the siting of the current Bowie High School campus itself “had segregatory consequences” (1).
With the move of 112 busses to Bowie High School, Bowie, will experience more pollution than the Northeast Hub or the West Hub. In research done by Deb Niemeier, emissions generated at the Northeast hub will be approximately 36% lower compared to Bowie and the West hub will experience emissions approximately 25% lower compared to Bowie (5). Below, in Table 1, is the relative comparison of pollutant load at the other hubs compared to the pollutant load at Bowie High School.

**Table 1. Comparison of pollutant load of Northeast and West Hub compared to Bowie**

<table>
<thead>
<tr>
<th>% Relative to Bowie</th>
<th>PM10</th>
<th>PM2.5</th>
<th>PM10</th>
<th>NOx</th>
<th>HC</th>
<th>VOC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bowie High School Hub</td>
<td>225.6</td>
<td>305.0</td>
<td>1041.4</td>
<td>3516.6</td>
<td>396.6</td>
<td>438.3</td>
</tr>
<tr>
<td>Northeast Hub (35% Lower)</td>
<td>143.0</td>
<td>195.5</td>
<td>671.1</td>
<td>2238.2</td>
<td>254.2</td>
<td>279.9</td>
</tr>
<tr>
<td>West Hub (25% Lower)</td>
<td>168.2</td>
<td>228.8</td>
<td>772.7</td>
<td>2645.7</td>
<td>293.7</td>
<td>323.7</td>
</tr>
</tbody>
</table>

EPISD receives federal funding from Department of Education, Department of Transportation, Department of Justice, and Department of Health and Human Services (1). Therefore, EPISD must comply with Title VI Civil Rights act of 1964 and follow the regulations. EPISD’s project as planned violate Title VI because it would cause disparate impacts to students at Bowie High School. This includes harmful air pollution that is based on race and national origin (1).

**EPA’s School Sitting Guidelines**

EPA’s School Sitting Guidelines are guidelines set by the EPA intended protect children from environmental hazards. The EPA’s goals within these guidelines are to “encourage, inform, and improve consideration of environmental factors in local school siting decision-making processes without infringing on local decision-making authority” (6). The EPA recommends that schools should avoid locations containing “environmental factors, hazards, and sources of air pollution before a site is built” (1). The EPA specifically lists “bus terminals with more than 100 busses a day as a problematic pollution generating land use if less than half a mile from a school site” (1).

By constructing the bus hub at Bowie High School, the pollutant load of PM2.5 estimates to be around 225.6 lb per year and NOx estimates to be around 3516.6 lb per year (5). Relating the lbs per year of PM2.5 and NOx to passively smoked cigarettes per day, it is estimated that the PM2.5 concentrations are equivalent to 3-8 passive cigarettes and NO2 concentrations are equivalent to 6-12 passive cigarettes smoked per student per day (5). This information can be found by using a Box Model and convert the hourly emissions to concentrations. The concentrations can then be expressed into passive cigarette-equivelents for an exposure time period using an upper and lower bound of idling at the bus hub (5).
According to the EPA’s School Sitting Guidelines, the proposed bus hub should not be constructed at Bowie High School. The proposed bus hub at Bowie would hold more than the 100-bus limit and increase the amount of air pollution of the High School and surrounding areas. Relating the air pollution to passively smoked cigarettes smoked per day, in total, students may experience the equivalent of between 9 to 20 passively smoked cigarettes per day due to the PM2.5 and NO2 pollutants generated by buses.

**National Ambient Air Quality Standards**

The Clean Air act requires the EPA to set National Ambient Air Quality Standards (NAAQS). The NAAQS sets standards for pollutants considered harmful for public health and the environment. The EPA has set National Ambient Air Quality Standards for six principal pollutants, which are called "criteria" air pollutants. These pollutants include Carbon monoxide, Lead, Nitrogen Dioxide, Ozone, Particle Pollution (PM), and Sulfur Dioxide (7). El Paso has also been found to be moderate standing for the National Ambient Air Quality Standards for PM10. PM10 is the most harmful of air pollutants that can increase the severity of asthma attacks cause or aggravate other lung diseases (1). Bowie High School also suffers from high concentrations of ultra fine particles because of its proximity to the Bridge of Americas. These particles have detrimental effects such as “increased morbidity and mortality in those with respiratory and cardiac conditions”(1) In addition, Bowie High School falls within the El Paso Maintenance Area for Carbon Monoxide. As a result, the state of Texas has adopted revisions to bring the area into compliance with NAAQS, however, EPISD’s plan of placing a bus hub at Bowie, at minimum, should be re-evaluated for compliance with the federal standards.

**Summary of the Injustices**

According to the Title VI Civil Rights Act of 1964 and the EPA’s School Sitting Guidelines, the proposed bus hub should not be constructed at Bowie High School. EPISD’s project as planned will cause disparate impacts to students at Bowie High School in air pollution, therefore, violating Title VI. The proposed bus hub also violates EPA’s School Sitting Guidelines for its proposed location will generate a large source of air pollution and will hold more than the 100-bus limit. Based on the National Ambient Air Quality Standards, Bowie High School currently is in moderate standing for PM10 and falls within the El Paso Maintenance Area for Carbon Monoxide. Although currently Bowie High School is in compliance with NAAQS, with the added pollution from the movement of the proposed bus hub, Bowie High School may not be in compliance in the future.

**Comparing Diesel vs Propane Busses**

Based on EPISD’s comment to have “only propane powered busses by 2022”, we calculated the emissions difference by assuming a 100% conversion of Bowie’s bus fleet from diesel to propane (3). To do this we used the AFLEET tool generate the amount of emissions per year of CO, NOx, PM2.5, PM10, VOC and VOC (Evap).
To generate the pollutant load of diesel busses in the AFLEET tool, first, we changed the city and state to El Paso, Texas. This allows for us to generate the pollutant load specific to El Paso. Next, under the “Footprint Calculator” we selected the row labeled “school bus” under the vehicle type. We used school bus as the vehicle type because this is the main vehicle within Bowie’s Fleet. Within the row of “School Bus”, we entered 2018 as the vehicle age, 523,972 for the vehicle miles, diesel as fuel type, and 8 for miles per gallon. We set the number of miles to 523,972 because these are the total annual miles Bowie’s Fleet would be traveling per year (8). We set the fuel type as diesel and miles per gallon as 8 for this is the fuel type and the average miles per gallon used when diesel busses run. We used 2018 as the vehicle age to standardize the comparison between diesel and propane busses. This is a generalization because the current fleet of diesel busses is comprised of various vehicles ages ranging from 2002-2017. The variation in model year of diesel busses leads to a variation in emissions rate. For example, vehicles made in 2002 would have a larger pollutant load than vehicles made in 2017. However, to standardize the comparison and use the best-case scenario, we used 2018 as the vehicle age for both propane and diesel busses.

Steps to generate the pollutant load of diesel busses using AFLEET tool:

1. Change the State and City from the drop-down menu to El Paso, Texas
2. Select school bus from the rows of vehicles in the excel sheet
3. Enter 2018 as the vehicle age
4. Enter 523,972 for miles (These are the total amount of miles the fleet of busses at Bowie High School would run per year)
5. Select diesel as the fuel
6. In the miles per gallon column enter 8

After all the inputs were within the AFLEET tool, emissions of CO, NOx, PM2.5, PM10, VOC and VOC (Evap) were generated. The output, as seen in table 2, shows the pollutant load per year of Bowie’s fleet of 124 diesel busses.

Table 2: Pollutant Load Per Year of 124 Diesel Busses

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>CO</th>
<th>NOx</th>
<th>PM10</th>
<th>PM10 (TBW)</th>
<th>PM2.5</th>
<th>PM2.5 (TBW)</th>
<th>VOC</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>1147.5</td>
<td>679.50</td>
<td>11.55</td>
<td>117.82</td>
<td>10.396</td>
<td>15.017</td>
<td>55.447</td>
<td>33.290</td>
</tr>
</tbody>
</table>

Similarly, to find the pollutant load of propane busses we used the same steps as before but changed the fuel type to propane and changed the miles per gallon as 6. We kept the city and state as El Paso, Texas, vehicle age as 2018, and 523,972 as the miles the same for this would allow for an accurate comparison.

Steps to generate the pollutant load of propane busses using AFLEET tool:

1. Change the State and City from the drop-down menu to El Paso, Texas
2. Select school bus from the rows of vehicles in the excel sheet
3. Enter 2018 as the vehicle age
4. Enter 523,972 for miles (These are the total amount of miles the fleet of busses at Bowie High School would run per year)
5. Select propane as the fuel
6. In the miles per gallon column enter 6

After all the inputs were within the AFLEET tool, emissions of CO, NOx, PM2.5, PM10, VOC and VOC (Evap) were generated. The output, as seen in table 3, shows the pollutant load per year of Bowie’s fleet of 124 propane busses.

### Table 3: Pollutant Load Per Year of 124 Propane Busses

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>CO</th>
<th>NOx</th>
<th>PM10 (TBW)</th>
<th>PM10 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>VOC</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>14512.9</td>
<td>436.00</td>
<td>11.551</td>
<td>117.826</td>
<td>10.3964</td>
<td>15.01709</td>
<td>107.42</td>
<td>682.69</td>
</tr>
</tbody>
</table>

#### Results: Comparing Pollutant Load of Diesel and Propane Busses

After generating the AFLEET results of CO, NOx, PM10, PM10(TBW), PM2.5, PM2.5(TBW), VOC, and VOC (Evap) emissions of the diesel and propane busses, to compare the two, we subtracted the diesel emissions from the propane emissions. By doing this we would expect a positive number, meaning, the diesel emissions would be greater than the propane emissions. However, as seen in table 4 below, the emissions of CO, VOC, and VOC (Evap) all contain negative numbers. This means that the pollutant load of the fleet of diesel busses was smaller than the pollutant load of the fleet of propane busses for CO, VOC, and VOC (Evap). The only positive number seen was in NOx emissions which means that the generated pollutant load of propane emissions was smaller than the pollutant load of diesel emissions.

### Table 4: Difference in pollutant load

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>CO</th>
<th>NOx</th>
<th>PM10 (TBW)</th>
<th>PM10 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>VOC</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propane</td>
<td>14512.9</td>
<td>436.00</td>
<td>11.551</td>
<td>117.826</td>
<td>10.3964</td>
<td>15.01709</td>
<td>107.42</td>
<td>682.69</td>
</tr>
<tr>
<td>Diesel</td>
<td>1147.53</td>
<td>679.50</td>
<td>11.551</td>
<td>117.826</td>
<td>10.3964</td>
<td>15.01709</td>
<td>55.44711</td>
<td>33.2902</td>
</tr>
<tr>
<td>Difference</td>
<td>-13365.4</td>
<td>243.5</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-51.982</td>
<td>-649.41</td>
</tr>
</tbody>
</table>

EPISD stated that “propane vehicles can produce lower amounts of some harmful air pollutants and greenhouse gasses” (3). This comment was true for one pollutant but not all. By switching the whole fleet of busses to propane, there would be an added 13365.4 pounds per year of CO, an added 51.9822 pounds per year of VOC, and an added 649.41 pounds per year of VOC (Evap). The only reduction of emissions would be in 243.5021 pounds of NOx per year. There would be no change in emissions of PM10, PM10(TWB), PM2.5, and PM2.5 (TBW).
Comparing Diesel vs Propane Busses Idling times

To compare the pollutant load generated from the idling times of diesel and propane busses we used the AFLEET tool again. Similar to generating the pollutant load from running the diesel and propane busses per year, we started by setting the city and state to El Paso, Texas. Our next step was to convert idling times to miles. Using increments of 5, we decided to measure idling times at 5, 10, 15, and 20 minutes. For each minute of idling half a mile is traveled (3). Multiplying each of the idling times by ½ we got converted idling minutes to miles traveled per bus per day. In order to get the amount of converted idling minutes to miles traveled for the whole fleet of Bowie’s busses we multiplied our converted miles traveled per day by 124, the total amount of busses. In order to get the amount of converted idling miles per year of the whole fleet, we multiplied the converted idling minutes traveled by the whole fleet by 365. Seen below in table 8, is a chart showing how we converted the idling times to miles per year traveled of the whole Bowie fleet. The reason why we are converted idling times to miles per year is to match the input “Annual Vehicle Mileage” on the AFLEET tool. This conversion allows us to generate the pollutant load per year from idling times of the propane and diesel busses.

Steps to convert idling times to miles traveled per year
1. Given idling times of 5, 10, 15, and 20 minutes, multiply each by .5 (This converts the idling times of the busses to miles)
2. Multiply the converted miles from above by 124 (This gives us the number of miles traveled by the Bowie’s fleet of busses)
3. Multiply the converted miles of Bowies fleet from above by 365 (This gives us the converted number of miles per year)

Table 5: Converting Idling times to Miles traveled per year of the whole Bowie fleet

<table>
<thead>
<tr>
<th>Idling Times</th>
<th>Miles Traveled Per Day (Idling Times * ½)</th>
<th>Miles Traveled by Fleet Per Day (Traveled Per Day * 124)</th>
<th>Miles Traveled Per Year by Fleet (Miles Total by Fleet Per Day * 365)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2.5</td>
<td>310</td>
<td>113150</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
<td>620</td>
<td>226300</td>
</tr>
<tr>
<td>15</td>
<td>7.5</td>
<td>930</td>
<td>339450</td>
</tr>
<tr>
<td>20</td>
<td>10</td>
<td>1240</td>
<td>452600</td>
</tr>
</tbody>
</table>

Our next step was to get the distance of the busses leaving the bus hub per year. In order to do this, we multiplied .25 (the distance to get out of the bus hub) by the 124 (the total amount of busses). This gets us the distance traveled of all of the busses per day. To get the amount of distance traveled per year, we multiplied the distance traveled of all the busses per day by 365. Seen below in table 6, is a chart showing the conversion of the miles traveled per year of all of the busses from traveling out of the parking lot.
Steps to get the distance per year traveled by Bowie’s fleet leaving the parking lot
1. The distance traveled to get out of the parking lot for each bus is .25 miles
2. Multiply .25 by 124 to get the total distance per day the busses travel leaving the parking lot
3. Multiply the above distance by 365 (This gets us the total distance per year traveled by the busses leaving the parking lot)

Table 6: Distance per year traveled by busses leaving the parking lot

<table>
<thead>
<tr>
<th>Parking Lot Distance (Miles)</th>
<th>Total Distance Per Day (Parking Lot Distance * 124)</th>
<th>Total Distance Per Year (Distance Per Day * 365)</th>
</tr>
</thead>
<tbody>
<tr>
<td>.25</td>
<td>31</td>
<td>11315</td>
</tr>
<tr>
<td>.25</td>
<td>31</td>
<td>11315</td>
</tr>
<tr>
<td>.25</td>
<td>31</td>
<td>11315</td>
</tr>
<tr>
<td>.25</td>
<td>31</td>
<td>11315</td>
</tr>
</tbody>
</table>

Our third step was to add the distance traveled by idling and the distance traveled leaving the parking lot. This will give us a combined total of the amount traveled by Bowie’s 124 busses. As seen in table 10, we add the miles per year of the total fleet with the distance per day. This gives us the equivalent number of miles per year from Bowie’s idling busses.

Table 7: Distance of Parking lot and Converted Idling times

<table>
<thead>
<tr>
<th>Miles Per Year of Total Fleet (Miles of Total Fleet * 365)</th>
<th>Total Distance Per Day * 365</th>
<th>Added Total (Miles Per Year + Total Distance Per Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>113150</td>
<td>11315</td>
<td>124465</td>
</tr>
<tr>
<td>226300</td>
<td>11315</td>
<td>237615</td>
</tr>
<tr>
<td>339450</td>
<td>11315</td>
<td>350765</td>
</tr>
<tr>
<td>452600</td>
<td>11315</td>
<td>463915</td>
</tr>
</tbody>
</table>

Next, using the converted total miles from Bowie’s idling times we used to AFLEET tool to get the pollutant load of propane and diesel busses. We imputed these numbers into the AFLEET’s tool “Vehicle Mileage” tab. For both propane and diesel busses we will input 124,465 miles for the equivalent of 5 minutes of idling, 237,615 for the equivalent of 10 minutes of idling, 350,765 for the equivalent of 15 miles of idling, and 463,915 for the equivalent of 20 minutes of idling. Entering these values in for the vehicle mileage, city and state being El Paso Texas, and 2018 as the vehicle age we can generate the pollutant load for the idling times for the fleet of diesel and propane busses. Tables 8 and 9 contain the expected pollutant load from the idling times of propane and diesel busses.

Steps to generate the pollutant load of the idling times of a fleet of diesel busses
1. Change the State and City from the drop-down menu to El Paso, Texas
2. Select school bus from the rows of vehicles in the excel sheet
3. Enter 2018 as the vehicle age
4. Select diesel as the fuel
5. In the miles per gallon column enter 8
6. Enter 124,465, 237,615, 350,765, 463,915 for vehicle mileage (These are the converted idling times to number of miles the fleet of busses at Bowie High School would run per year. This will generate 4 outputs)

Table 8: Expected Output of the Pollutant Load of Fleet of Diesel Busses

<table>
<thead>
<tr>
<th>Idling times (Minutes)</th>
<th>Vehicle Age</th>
<th>Annual Vehicle Mileage</th>
<th>Fuel Type: Diesel (MPG)</th>
<th>CO</th>
<th>NOx</th>
<th>PM10 (TBW)</th>
<th>PM10 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2018</td>
<td>124465</td>
<td>8</td>
<td>272.5</td>
<td>161.4</td>
<td>2.744</td>
<td>27.98</td>
<td>2.469</td>
<td>3.567</td>
<td>13.17</td>
</tr>
<tr>
<td>10</td>
<td>2018</td>
<td>237615</td>
<td>8</td>
<td>520.3</td>
<td>308.1</td>
<td>5.238</td>
<td>53.43</td>
<td>4.714</td>
<td>6.81</td>
<td>25.14</td>
</tr>
<tr>
<td>15</td>
<td>2018</td>
<td>350765</td>
<td>8</td>
<td>768.2</td>
<td>454.8</td>
<td>7.733</td>
<td>78.87</td>
<td>6.959</td>
<td>10.05</td>
<td>37.11</td>
</tr>
<tr>
<td>20</td>
<td>2018</td>
<td>463915</td>
<td>8</td>
<td>1016</td>
<td>601.6</td>
<td>10.22</td>
<td>104.3</td>
<td>9.204</td>
<td>13.3</td>
<td>49.09</td>
</tr>
</tbody>
</table>

Steps to generate the pollutant load of the idling times of a fleet of propane busses

1. Change the State and City from the drop-down menu to El Paso, Texas
2. Select school bus from the rows of vehicle in the excel sheet
3. Enter 2018 as the vehicle age
4. Select propane as the fuel
5. In the miles per gallon column enter 6
6. Enter 124,465, 237,615, 350,765, 463,915 for vehicle mileage (These are the converted idling times to number of miles the fleet of busses at Bowie High School would run per year. This will generate 4 outputs)

Table 9: Expected Output of the Pollutant Load of Fleet of Propane Busses

<table>
<thead>
<tr>
<th>Idling times (Minutes)</th>
<th>Vehicle Age</th>
<th>Annual Vehicle Mileage</th>
<th>Fuel Type: LPG (MPG)</th>
<th>CO</th>
<th>NOx</th>
<th>PM10 (TBW)</th>
<th>PM10 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>2018</td>
<td>124465</td>
<td>6</td>
<td>3447</td>
<td>103.5</td>
<td>2.74</td>
<td>27.98</td>
<td>2.469</td>
<td>3.567</td>
<td>25.51</td>
</tr>
<tr>
<td>10</td>
<td>2018</td>
<td>237615</td>
<td>6</td>
<td>6581</td>
<td>197.7</td>
<td>5.23</td>
<td>53.43</td>
<td>4.714</td>
<td>6.81</td>
<td>48.71</td>
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<tr>
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<td>2018</td>
<td>350765</td>
<td>6</td>
<td>9715</td>
<td>291.8</td>
<td>7.73</td>
<td>78.87</td>
<td>6.959</td>
<td>10.05</td>
<td>71.91</td>
</tr>
<tr>
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<td>2018</td>
<td>463915</td>
<td>6</td>
<td>12849</td>
<td>386.0</td>
<td>10.2</td>
<td>104.3</td>
<td>9.204</td>
<td>13.3</td>
<td>95.11</td>
</tr>
</tbody>
</table>

Results: Comparing Propane and Diesel Idling times

From the expected propane and diesel emissions generated in tables 8 and 9, we then subtracted each row of diesel output from the corresponding row of the propane output. The difference in idling times can be seen in table 10. By doing this we would expect a positive number, meaning, the propane emissions would be greater than the diesel emissions. However, as seen in table 10 below, the emissions of CO, VOC, and VOC (Evap) all contain negative numbers. This means that
the pollutant load of the fleet of propane busses was greater than the pollutant load of the fleet of diesel busses for CO, VOC, and VOC (Evap). The only positive number seen was in NOx emissions which means that the generated pollutant load of diesel emissions was larger than the pollutant load of propane emissions.

Table 10: Difference Between Diesel and Propane Idling Times in Pounds Per year

<table>
<thead>
<tr>
<th>Idling times (Minutes)</th>
<th>CO</th>
<th>NOx</th>
<th>PM10 (TBW)</th>
<th>PM10 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>PM2.5 (TBW)</th>
<th>VOC (Evap)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>-3174.8</td>
<td>57.842</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-12.348</td>
</tr>
<tr>
<td>10</td>
<td>-6061</td>
<td>110.43</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-23.573</td>
</tr>
<tr>
<td>15</td>
<td>-8947.2</td>
<td>163.01</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-34.799</td>
</tr>
<tr>
<td>20</td>
<td>-11833</td>
<td>215.59</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-46.024</td>
</tr>
</tbody>
</table>

By switching the whole fleet of busses to propane, there would be an added 3174.8 pounds per year of CO, an added 12.348 pounds per year of VOC, and an added 154.3 pounds per year of VOC (Evap) for every 5 minutes of idling. For every 10 minutes of idling there would be an added 6061 pounds per year of CO, an added 23.573 pounds per year of VOC, and an added 294.5 pounds per year of VOC (Evap). For every 15 minutes of idling there would be an added 8947.2 pounds per year of CO, an added 34.799 pounds per year of VOC, and an added 434.7 pounds per year of VOC (Evap) for every 15 minutes of idling. Finally, there would be an added 11833 pounds per year of CO, an added 46.024 pounds per year of VOC, and an added 575 pounds per year of VOC (Evap) for every 20 minutes of idling. The only reduction of emissions would be 57.842 in pounds of NOx per year for 5 minutes of idling, 110.43 in pounds of NOx per year for 10 minutes of idling, 163.01 in pounds of NOx per year for 15 minutes of idling, and 215.59 in pounds of NOx per year for 20 minutes of idling. There would be no change in emissions of PM10, PM10(TWB), PM2.5, and PM2.5 (TBW).

Conclusions:

Our goal of this study was to provide evidence for Texas RioGrande Legal Aid Group case against EPISD’s proposed plan to construct the central operations bus hub at Bowie High School. Through this study we were able to analyze the Title VI Civil Rights Act of 1964, EPA’s School Sitting Guidelines, and National Ambient Air Quality Standards. The most important of the three would be Title VI. Title VI “prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance” (1). El Paso Independent School District receives federal financial assistance from the Department of Education, Department of Transportation, Department of Justice, and Department of Health and Human Services (1). Therefore, EPISD must comply with Title VI Civil Rights Act of 1964. However, the school district’s current plan violates Title VI for the busses are used in a discriminatory manner. Bowie High School has suffered from a history of discrimination and consists of a 97.6% Hispanic, 1.5% Black, and 0.9% White population. In addition, 50% of the students were English Language Learners and 82.2% were considered economically
disadvantaged (1). By moving the bus hub to Bowie, emissions will be approximately 36% higher and 25% higher at Bowie compared to the other two bus hubs. EPISD’s project as planned violate Title VI because it would cause disparate impacts to students at Bowie High School. This includes harmful air pollution that is based on race and national origin. Therefore, the proposed bus hub should not be constructed at Bowie High School.

Our second objective was to compare the pollutant load of a fleet of diesel busses and propane busses. This is based off of EPISD’s plan switch the entire fleet of diesel busses to propane. According to EPISD propane busses will “lower amounts of harmful air pollutants” and “include the reduction of particulate emissions” (3). To do this, we used the AFLEET tool comparing 2018 diesel buses comparing 2018 propane buses. In this study, we found that by switching the entire fleet of busses to propane, the amount of CO, VOC, and VOC (Evap) emissions would increase. The only reduction in emissions would be in NOx. There would be no change in emissions of PM2.5, PM2.5 (TBW), PM10, and PM10 (TBW). When comparing the emissions generated from idling of propane and diesel busses we found the same conclusion. Since there would be an increase in three particulate emissions (CO, VOC, and VOC (Evap), no change in 4 particulate emissions (PM2.5, PM2.5 (TBW), PM10, and PM10 (TBW)), and only a decrease in NOx, it can be concluded that the propane solution provided by EPISD is not sufficient enough to reduce the added pollution by moving a bus hub to Bowie High School. Therefore, the bus hub should not be constructed because EPISD’s proposed plan violates Title VI Civil Rights Act of 1964 and switching the fleet of busses to propane is not a sufficient plan to reduce the added pollution by moving a bus hub to Bowie High School.
References:

8. Deb Niemeier, BusesOrdered, Sustainable Systems Research, LLC, California, 2018, Accessed July 13, 2018