Program Background

• Senate Bill 110 (SB 110) allocates up to $75 million for school bus replacement grants.
• Under SB 110 all replaced school buses must be scrapped.
• All project expenditures from the Job Creation Fund shall be cost effective: total benefits shall be greater than project costs over time.
• Total benefits may include consideration of non-energy benefits, such as health and safety, in addition to energy benefits.
Program Design

Three complementary funding components:

1. School bus replacement (2 phases)
   - Phase 1: Solicit public school districts, county offices of education, and joint power authorities to establish a ranked list of buses eligible for replacement based on applications received.
   - Phase 2: Solicit manufacturers to design, construct, and deliver the replacement electric buses to applicants awarded in Phase 1. This phase is a separate solicitation which is planned for release in late 2018.

3. Provide workforce training and development opportunities and resources to support electric school bus maintenance, charging, and operations (ARFVTP funding).
# Milestone Targets

<table>
<thead>
<tr>
<th>Activity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>School District Solicitation Release</td>
<td>May 31, 2018</td>
</tr>
<tr>
<td>Applications Due</td>
<td>September 20, 2018</td>
</tr>
<tr>
<td>Post Electric School Bus Rank List and CNG School Bus Notice of Proposed Awards (NOPA)</td>
<td>November 2018</td>
</tr>
<tr>
<td>Release Bulk Pricing for Electric Buses Solicitation</td>
<td>Q4 2018</td>
</tr>
<tr>
<td>Business Meeting Approval - CNG School Buses</td>
<td>Q1 2019</td>
</tr>
<tr>
<td>Award Manufacturer(s)/Dealer(s)</td>
<td>Q1 2019</td>
</tr>
<tr>
<td>Award Electric School Buses (Final NOPA)</td>
<td>Q1 2019</td>
</tr>
<tr>
<td>Install Infrastructure</td>
<td>April - December 2019</td>
</tr>
<tr>
<td>Begin Delivering Electric School Buses</td>
<td>Q4 2019</td>
</tr>
</tbody>
</table>
## GFO-17-607 Scoring Results

### Analysis of All Buses Eligible for Electric Vehicle Replacement

<table>
<thead>
<tr>
<th>Regions</th>
<th>Number of Applying Local Education Agencies</th>
<th>Number of Buses 1999 and Older</th>
<th>Total Number of Buses Eligible for Replacement</th>
<th>Percentage of Eligible Buses 1999 and Older</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>53</td>
<td>249</td>
<td>444</td>
<td>56%</td>
</tr>
<tr>
<td>Central</td>
<td>99</td>
<td>420</td>
<td>602</td>
<td>70%</td>
</tr>
<tr>
<td>LA County</td>
<td>12</td>
<td>53</td>
<td>86</td>
<td>62%</td>
</tr>
<tr>
<td>Southern</td>
<td>35</td>
<td>256</td>
<td>417</td>
<td>61%</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>199</strong></td>
<td><strong>978</strong></td>
<td><strong>1,549</strong></td>
<td><strong>63%</strong></td>
</tr>
</tbody>
</table>
GFO-17-607 Scoring Results

## Ranking: Analysis of Top 75 Buses in each Region

<table>
<thead>
<tr>
<th>Regions</th>
<th>Number of Applying Local Education Agencies</th>
<th>Age Range of Buses</th>
<th>Total Score Range</th>
<th>Bus Type A Requests</th>
<th>Bus Type C Requests</th>
<th>Bus Type D Requests</th>
<th>TBD Bus Type Requests</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>24</td>
<td>1983 - 1997</td>
<td>81.9 to 98</td>
<td>20</td>
<td>14</td>
<td>41</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Central</td>
<td>32</td>
<td>1978 - 1992</td>
<td>87.7 to 99.2</td>
<td>5</td>
<td>5</td>
<td>61</td>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>LA County</td>
<td>12</td>
<td>1984 - 2004</td>
<td>59.2 to 95</td>
<td>24</td>
<td>17</td>
<td>34</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td>Southern</td>
<td>15</td>
<td>1985 - 1997</td>
<td>82.5 to 95.4</td>
<td>2</td>
<td>11</td>
<td>62</td>
<td></td>
<td>75</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td><strong>83</strong></td>
<td></td>
<td></td>
<td><strong>51</strong></td>
<td><strong>47</strong></td>
<td><strong>198</strong></td>
<td><strong>4</strong></td>
<td><strong>300</strong></td>
</tr>
</tbody>
</table>
Cost Effectiveness Methodology

• Savings to Investment Ratio: \( \frac{\text{Total Project Benefits}}{\text{Total Project Costs}} \)

• If quotient is greater than or equal to 1, total project benefits exceed total project costs.

• If quotient is less than 1, total project costs exceed total project benefits.

• Our quotient for this project equals 1.15.
Equations Used

• Present value given an annual value:

\[ P = A \times \frac{1 - (1 + i)^{-n}}{i} \]

• Present value given a future value:

\[ P = F \times \frac{1}{(1 + i)^n} \]
Assumptions and Givens

• Analyzed most expensive type of bus: Type D
• Lifespan = 20 years
• 2% discount rate
• 1 battery replacement at year 12 of operation
• Fuel Efficiency of Diesel Buses: 5.5 mpg*
• Fuel Efficiency of Electric Buses: 19.6 mpgge
• 13,666 vehicle miles traveled annually**

*Fuel Efficiencies provided by Greet’s AFLEET tool
**Annual vehicle miles traveled provided by South Coast AQMD courtesy of California Air Resources Board
Bus Used for Modeling Purposes
Assumed Costs

• Cost of Type D School Bus: Approximately $415,000

• Cost of Electric Vehicle Infrastructure: Up to $60,000

• Combined Cost: $475,000
Defined Benefits

1. Fuel Savings
2. Emissions Reductions
3. Maintenance Savings
4. Health
5. Economic
Potential Other Benefits

• Safety Benefits

• Grid Benefits

• Scrappage

• Job Creation
1. Fuel Savings

- Cost of diesel: $3.71 per gallon*
- Cost of electric: $3.26 per diesel gallon equivalent
- Forecasted price increase for diesel: 3.9% annually
- Forecasted price increase for transportation electricity: 3.1% annually

*Fuel costs and forecasting provided by U.S. Energy Information Administration
Fuel Savings Analysis

Diesel Lifetime Costs:

\[
\frac{13,666 \text{ miles}}{5.5 \frac{\text{miles}}{DGE}} \times \frac{$3.71}{DGE} \times \frac{1-(1+0.02+0.039)^{-20}}{0.02+0.039} = $106,597.34
\]

Electric Lifetime Costs:

\[
\frac{13,666 \text{ miles}}{19.6 \frac{\text{miles}}{DGE}} \times \frac{$3.26}{DGE} \times \frac{1-(1+0.02+0.031)^{-20}}{0.02+0.031} = $28,088.18
\]

Difference: $78,509
2. Emissions Reductions

- Carbon intensity of diesel: 102.01 gCO2e/MJ*
- Carbon intensity of electricity: 105.16 gCO2e/MJ
- Cost of carbon: $15.10/MTCO2e**

*Low Carbon Fuel Standard stated carbon intensities
**Cap and Trade carbon price
Diesel Lifetime Costs:

\[
\frac{13,666 \text{ miles}}{5.5 \text{ miles/DGE}} \times 134.47 \frac{MJ}{DGE} \times \frac{102.01 \frac{gCO_2e}{MJ}}{1,000,000 \frac{gCO_2e}{MTCO_2e}} \times \frac{$15.10}{1 \text{ MTCO}_2e} \times \frac{1 - (1 + 0.02)^{-20}}{0.02} = \$8,415.49
\]

Electric Lifetime Costs:

\[
\frac{13,666 \text{ miles}}{19.6 \text{ miles/DGE}} \times 134.47 \frac{MJ}{DGE} \times \frac{105.16 \frac{gCO_2e}{MJ}}{1,000,000 \frac{gCO_2e}{MTCO_2e}} \times \frac{$15.10}{1 \text{ MTCO}_2e} \times \frac{1 - (1 + 0.02)^{-20}}{0.02} = \$2,434.41
\]

Difference: $5,981
3. Maintenance Savings

- Per mile maintenance cost of diesel: $0.88*
- Per mile maintenance cost of electric: $0.71
- Projected cost of replacement battery: $18,000 in 2030 or $14,193 in 2018 dollars**
- Per mile projected cost of replacement battery: $0.09

*CARB study of transit buses
**2018-2019 IEPR
Maintenance Savings Analysis

**Diesel Lifetime Costs:**

\[
13,666 \text{ miles} \times \frac{$0.88}{\text{mile}} \times \frac{1-(1+.02)^{-20}}{.02} = \$196,643.65
\]

**Electric Lifetime Costs:**

\[
13,666 \text{ miles} \times \frac{$0.71}{\text{mile}} \times \frac{1-(1+.02)^{-20}}{.02} = \$158,655.67
\]

**Difference:** \$37,988
4. Health Benefits

- Diesel Emissions Quantifier (DEQ) used quantify dollar savings due to emissions reductions.*
- Monetary values based on avoided incidences of:
  - Premature mortality
  - Chronic bronchitis
  - Acute bronchitis
  - Upper and lower respiratory symptoms
  - Asthma exacerbation
  - Nonfatal heart attacks
  - Hospital admissions
  - Emergency room visits
  - Work loss days
  - Minor restricted-activity days

*U.S. Environmental Protection Agency
## DEQ Outputs and Analysis

### County and Region

<table>
<thead>
<tr>
<th>County and Region</th>
<th>Annual Diesel PM2.5 Reduction (Short Tons)</th>
<th>Annual Health Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modoc, North</td>
<td>0.003</td>
<td>$85*</td>
</tr>
<tr>
<td>Los Angeles, Los Angeles</td>
<td>0.003</td>
<td>$7,800</td>
</tr>
<tr>
<td>Mono, Central</td>
<td>0.003</td>
<td>$190*</td>
</tr>
<tr>
<td>Imperial, South</td>
<td>0.003</td>
<td>$780</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td><strong>0.014</strong></td>
<td><strong>$8,900</strong></td>
</tr>
</tbody>
</table>

### Lifetime Benefit Calculation

\[
\text{Lifetime Benefit Calculation: } \$8,900 \times \frac{1-(1+.02)^{-20}}{.02} = \$145,527.76
\]

*Indicates no applicants from these counties through GFO-17-607*
5. Economic Benefits

- Used Regional Input-Output Modeling System (RIMS II).*
- Multipliers:
  - 1.4516 for construction
  - 1.4105 for motor vehicles, bodies and trailers, and parts manufacturing
  - 1.4467 for out of state industry

*Bureau of Economic Analysis
### Economic Multipliers

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
<th>Multiplier</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td>$55,000</td>
<td>1.4516</td>
<td>$79,838</td>
</tr>
<tr>
<td>Motor vehicles, bodies and trailers, and parts manufacturing</td>
<td>$108,750</td>
<td>1.4105</td>
<td>$153,392</td>
</tr>
<tr>
<td>Other out-of-state industry</td>
<td>$31,125</td>
<td>1.4467</td>
<td>$45,029</td>
</tr>
<tr>
<td><strong>Totals:</strong></td>
<td><strong>$194,875</strong></td>
<td></td>
<td><strong>$278,258</strong></td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Fuel Savings</td>
<td>$78,509</td>
</tr>
<tr>
<td>2. Emissions Reductions</td>
<td>$5,981</td>
</tr>
<tr>
<td>3. Maintenance Savings</td>
<td>$37,988</td>
</tr>
<tr>
<td>4. Health</td>
<td>$145,528</td>
</tr>
<tr>
<td>5. Economic</td>
<td>$278,258</td>
</tr>
</tbody>
</table>

**Total Benefits:** $546,264
Total Project Benefits exceed Total Project Costs by $71,264.
Thank You!