Marin Transit's Board of Directors approved the purchase of two BYD Battery Electric Buses on November 21, 2016. The buses entered service in July 2019 and are operated by Golden Gate Transit. The results here are from July 1, 2019 to June 30, 2020. Staff continues to monitor the bus performance.

**Vehicle Information**

- **Make/Model:** BYD K9S Low-floor Transit Bus
- **Length:** 35.8 ft
- **Battery:** BYD Iron Phosphate 270kWh
- **Advertised Range:** 145 mi
- **Seating Capacity:** 32
- **Wheelchair positions:** 2
- **Charging:** Overnight, 3-4 hours
- **Capital Project Cost:** ~$1.6 Million

**Vehicle Routing**

Operated by Golden Gate Transit, the vehicles ran on Routes 23, 23X, 29, 17, and 71X. Each of these routes is relatively flat. Route 71X travels the most time on the freeway with the fewest stops.

**Bus Charging**

Marin Transit chose depot charging for the first two buses. Due to electrical rate schedules, this method is the most cost-effective. Charging infrastructure only had to be installed in the yard. Buses operated in service during the day and charged overnight.

**Miles Operated:** 32,283  
**Average Range Observed:** 133 miles  
**Maintenance Issues:** Broken Mirror  
**Average Fuel Cost/Mile:** $1.09  
**Carbon Savings:** 5,285 kg CO₂  
**Routes:** 23, 23X, 29, 17, 71X
Marin Transit evaluated vehicle performance, cost to operate, vehicle reliability, and emissions reductions. The full board report and analysis can be found at www.marintransit.org/projects/two-battery-electric-buses.

**Vehicle Performance and Consumption**

- Average vehicle consumption averaged 1.63 kWh/mile (about 133 miles on a single charge). This is 8 miles short of the advertised vehicle range of 145 miles.
- Temperature had some impact, cooler temperatures resulting in slightly higher consumption.
- No relationship was found between consumption and speed.
- Average Performance on each route was similar.
- The average performance on route 71X was the highest, likely because it buses on this route travel at faster speeds on the freeway with less stops to take advantage of regenerative braking.
- Marin Transit feels comfortable operating the buses to 120 miles on a single charge under all conditions.

**Conclusions:**
- Buses can reliably travel 120 miles on a single charge
- More analysis is needed throughout the buses' lifecycle and on more routes

**Fleet Comparisons**

- The fuel cost per mile to operate the electric buses is more variable and more expensive than the cost to operate our diesel fleet
- The battery electric buses average about 17 miles per diesel gallon equivalent, compared to the hybrid diesel-electric buses which average 6 mpg.

**Conclusions:**
- Fuel costs are higher
- The battery electric buses use energy more efficiently than traditional fuel buses.

**Reliability/Availability**

- No roadcalls
- Vehicles are constrained by range.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>1801</th>
<th>1802</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days Used in Service:</td>
<td>216</td>
<td>210</td>
</tr>
<tr>
<td>Days Available:</td>
<td>338</td>
<td>352</td>
</tr>
<tr>
<td>Days Unavailable:</td>
<td>27</td>
<td>13</td>
</tr>
</tbody>
</table>

**Conclusions:**
- The technology is reliable

**Emissions Reductions**

- During their one year of operation, the two electric buses saved:
  - 5,285 kg of CO2
  - 127,000 g of NOx
  - 3,182 g of Particulate Matter
- This is equivalent to the yearly carbon sequestration of 7 acres of forest.

**Conclusions:**
- Battery Electric Buses reduce emissions.

**Next Steps...**

- Continue to monitor performance
- Test on routes with different profiles
- Expand to more routes
- Invest in more battery electric buses
- Purchase additional land for bus charging