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November 21, 2016

Honorable Board of Directors  
Marin County Transit District  
3501 Civic Center Drive  
San Rafael, CA 94903

**SUBJECT: Electric Bus Pilot Project and Purchase Agreement  
with BYD for Two Electric Buses**

Dear Board Members:

**board of directors**

kathrin sears  
president  
supervisor district 3

katie rice  
vice president  
supervisor district 2

stephanie moulton-peters  
2nd vice president  
city of mill valley

judy arnold  
director  
supervisor district 5

maribeth bushey  
director  
city of san rafael

damon connolly  
director  
supervisor district 1

steve kinsey  
director  
supervisor district 4

**RECOMMENDATION:** Authorize General Manager to complete the purchase of two Electric Buses from BYD, and approve Budget Amendment 2017-05.

**SUMMARY:**

Marin Transit is requesting authorization to move forward with the procurement of two 35-foot BYD zero emission battery electric vehicles as part of electric vehicle pilot project. These vehicles will replace two diesel vehicles owned by the Golden Gate Bridge Highway and Transportation District and operated under contract to Marin Transit. Each vehicle carries 32 seated passengers, and can operate on routes that have less than 80 vehicle miles per day.

*Background*

The California Air Resources Board (CARB) is working on the Advanced Clean Transit (ACT) rule to reduce emissions from conventional bus fleets by requiring use of renewable fuels and phasing-in zero emission bus purchases with the goal of transforming the fleet to entirely zero emission vehicles by the year 2040.

Marin Transit's 2015 Short Range Transit Plan (S RTP) states that reducing emissions and using alternative fuels is a priority. Marin Transit purchased its first seven diesel electric hybrid buses in 2010. The District currently operates 20 hybrid diesel electric buses, and has ordered another ten hybrid buses that will be delivered in 2017. Incorporating hybrid vehicles into the fleet has caused minimal disruption to operations, and the vehicles have provided an estimated 20 percent fuel savings. Hybrid buses are more expensive and require additional federal and local funding compared to diesel-only buses.

The District's S RTP Capital Plan included an unfunded Electric Vehicle Pilot Project for testing the technology. Battery-powered

buses provide an opportunity to reduce all local emissions but for prior vehicle replacements, the price and range (the number of miles a vehicle can drive on a single charge) have not made them a practical choice. Recent advances in battery and vehicle technology have resulted in prices comparable to hybrid vehicles and in driving ranges that are sufficient for some routes in our system.

The District also understands that electric vehicle technology is changing rapidly. A two vehicle pilot provides the opportunity to test the technology, gain experience with battery powered vehicles, and allow technology to improve even further before committing to a single solution or manufacturer for a larger fleet replacement.

### **Coordination and Partnerships**

In early 2014, MCE brought together a group of interested parties, including the Transportation Authority of Marin (TAM), Golden Gate Bridge Highway and Transportation District (GGBHTD) and Marin Transit, to discuss the possibility of bringing Electric Buses to the County. The group started meeting regularly to discuss funding opportunities and share agency goals. This group brought together multiple skills sets and perspectives. TAM has been able to help find resources for the project, MCE has been a resource in helping the group to understand electrical transmission and rate structures, and GGBHTD and the District bring knowledge of operating buses and the operational requirements to run a bus. Pending your Board's approval of this purchase, the group would continue to meet to support the project implementation and coordinate the monitoring and evaluation of the project.

### **Vehicle Selection**

*Slow Charge vs Fast Charge:* For the pilot project, Marin Transit first identified that purchasing a slow charging vehicle would allow the District to gain experience with operating battery electric buses while limiting investments in charging infrastructure and risks associated with electrical pricing. Slow charging vehicles have longer range, are typically operated on one battery charge per day and are charged at night. This allows buses to charge at the operator's yards rather than requiring specialized fast charge equipment at transit centers or along routes. Electrical prices are sensitive to both time of day and amount of electricity being pulled in a given moment. Drawing power slowly, at night takes advantage of lower electrical rates and is the best way to ensure the District receives reasonable electrical pricing.

*Vehicle Manufacturer:* Marin Transit staff is recommending using the Howard County procurement of the BYD bus because the vehicle offers a tested slow charge technology with a range compatible with several routes in our system, a 12 year battery warranty, and a promised delivery of 6-10 months from order date.

Several electric bus manufacturers were evaluated as options for Marin Transit's Electric Bus pilot project, including BYD, Proterra, New Flyer, and CCW. Gillig is working on an electric bus but does not yet have one on the market, so they were not included in the evaluation. Though not traditional bus builders, BYD and Proterra buses have the longest range, making them the most versatile choices. A comparison of the options from BYD and Proterra is in the chart below. A comparison with all manufacturers evaluated is included as an attachment to this letter.

**Table 1: Summary Comparison of Electric Vehicle Manufacturers**

|                                       | <b>BYD</b>                                     | <b>Proterra Slow Charge (XR)</b>  |
|---------------------------------------|--|---|
| <i>Lengths Available</i>              | 30', 35', 40', 60'                             | 35', 40'  |
| <i>Range</i>                          | >150 Miles                                     | 136 - 193   |
| <i>Battery Size</i>                   | 324 kWh  | 220 - 330 kWh   |
| <i>Charging</i>                       | Slow Charge                                    | Slow Charge – uses standard EV car charger (not included in purchase)     |
| <i>Costs</i>                          | Base 35' Bus - \$690,000<br>Charger - included | Base 35' Bus - \$669,000<br>Charger - \$39,000<br>Total - \$708,000       |
| <i>Warranty</i>                       | 12 year battery                                | 6 year, unlimited mileage, extended warranty offered at \$50K per vehicle |
| <i>Purchase to Delivery timeframe</i> | 10 months                                      | 18 months   |
| <i>Purchases by other Agencies</i>    | Soltrans, Sonoma, Stanford University          | Tri-Delta is purchasing slow-charge buses, but has not received them yet. |

Note: Full comparison included as an attachment to this letter

Estimates of performance for the two vehicles by BYD and Proterra are similar. Staff is recommending the BYD bus because of further testing throughout transit agencies, the 12 year battery warranty and the promised faster delivery time.

### **Procurement**

Marin Transit will be procuring the buses through a competitively bid contract from Howard County, Maryland. Howard County entered into a contract with BYD, Inc for the purchase of Battery Electric vehicles in 2015. Of the three options they have left on their contract, the County agreed to assign two of them to Marin Transit. These options were transferred to Marin Transit by assignment in October 2016.

Howard County runs transit service similar to Marin Transit in both urban and suburban areas. They are doing a demonstration of Electric Bus technology with a purchase of three vehicles and they intend to test for scalability as they learn more about operational and cost constraints of the vehicles. The District's requirements and goals match Howard County's making it an ideal contract to purchase from. Piggybacking off of this contract allows Marin Transit to purchase vehicles that meet the District's needs quickly without the administrative burden of initiating an independent procurement process.

### **Project Evaluation**

The goal of the pilot project is to gain experience with electric bus technology, and evaluate if and how this zero emission technology can be deployed more broadly in Marin County. Staff will compare the pilot vehicles to the District's hybrid and diesel vehicles and present the results to your Board. The primary factors Marin Transit staff will evaluate include:

- **Performance Metrics** – It is important to know the constraints of the vehicles, whether they have the expected range, how they perform on hilly terrain, and how air conditioning/heat affects range
  - Temperature – How outdoor temperature affects the efficiency of the battery system
  - Range – How far the vehicle travels
  - Fuel Economy – How much battery power is left at the end of a shift
- **Reliability Metrics** - The number one mission of Marin Transit is to deliver safe and reliable and transit service.
  - Miles between road calls – How long the vehicle travels before experiencing a failure that requires assistance from the road supervisor
  - Time out of service – Number of days a repair takes
- **Cost Metrics** – The cost comparisons will include the initial procurement costs and the safe operation costs
  - Electricity/Fuel costs – Electricity bills
  - Maintenance costs – Hours spent performing preventative maintenance and repairs
- **Scalability** – Questions will be answered on how and if we are able to expand Electric Bus service, such as:
  - How much will increasing electrical draw affect electricity costs?
  - How many routes are suitable for a typical EV range?
  - Will running selected routes entirely on electric vehicles increase the amount of vehicles needed to provide service or have other operational impacts?
  - Are there locations where an on-route chargers can be deployed?
  - Are there maintenance cost savings over those associated with hybrid and diesel buses?

These metrics are consistent with other studies such as the one from National Renewable Energy Laboratory (NREL) on Battery Electric Buses compared to Hydrogen Fuel Cell Buses, so that information can be shared and compared across agencies and regions.

## **Operations**

Marin Transit has identified several routes that are compatible with the range and geographic limitations of Battery Electric Vehicles and also require the larger vehicle size to accommodate higher ridership levels. These routes operate in and around central San Rafael and Ross Valley and include Routes 22, 23, 23X, and 29. Marin Transit has been meeting with contractors who operate these routes (Golden Gate Transit and Marin Airporth) to discuss infrastructure, maintenance, and monitoring requirements to implement this new technology. Specifically, these include impacts on data tracking, the need for additional staff training, and electrical upgrades.

On either contractor's property, upgrades to the electrical systems are estimated between \$150,000 and \$200,000. Through a request to TAM, Marin Transit has secured \$75,000 in Measure B Vehicle License Fee funding earmarked to support alternative fuel vehicles. The District is actively working to identify a source for the remaining funding.

Marin Transit will ask both contractors to submit information on infrastructure and additional operational costs. The final decision will be negotiated at a later date, and a contract amendment for operation of these vehicles will be brought to your Board at a future meeting.

**FISCAL/STAFFING IMPACT:**

Staff has worked to quantify the capital and operating costs of the electric vehicle pilot. There are inherent risks associated with implementing a new technology. Staff has worked to minimize and limit risks to the District through engaging stakeholders and limiting the scope of the project.

Purchase of two electric replacement vehicles is included in the adopted FY2016/17 Marin Transit Budget, with a total project budget of \$1.527 million. Staff is requesting that your Board approve Budget Amendment 2017-04 (Table 1) to increase the project budget to \$1.622 million. This increase reflects the additional grant funding, and recognizes the funded portion of the infrastructure costs. Once funding is secured, staff anticipates that an additional budget amendment will be needed for the balance of the infrastructure improvements. More information for each of the cost components is provided below.

**Table 2: Project Budget with Budget Adjustment 17-04**

| <b>Revenue</b>                           | <b>Total Project<br/>(Amendment<br/>17-04)</b> | <b>Two Electric<br/>Vehicles (EV)</b> | <b>Electric<br/>Vehicle<br/>Infrastructure<br/>(EI)</b> |
|--|--|---------------------------------------|---|
| FTA Section 5307                         | \$1,190,640                                    | \$1,190,640                           |   |
| Measure A                                | \$261,360                                      | \$261,360                             |   |
| BAAQMD Grant                             | \$135,022                                      | \$135,022                             |   |
| Measure B                                | \$75,000                                       |                                       | \$75,000  |
| <b>Total Revenue</b>                     | <b>\$1,662,022</b>                             | <b>\$1,587,022</b>                    | <b>\$75,000</b>   |
| <b>Expenses</b>                          |  |                                       |   |
| BYD Purchase                             | \$1,514,614 <sup>1</sup>                       | \$1,514,614 <sup>1</sup>              |   |
| Funded Infrastructure Costs              | \$75,000                                       |                                       | \$75,000  |
| Staff time, Contingency &<br>Inspections | \$70,000                                       | \$70,000                              |   |
| <b>Total Funded Expenses</b>             | <b>\$1,659,614</b>                             | <b>\$1,584,614</b>                    | <b>\$75,000</b>   |
| Unfunded Expenses                        | \$90,000                                       |                                       | \$90,000  |
| <b>Total Expenses</b>                    | <b>\$1,749,614</b>                             | <b>\$1,584,614</b>                    | <b>\$165,000</b>  |
| <b>Project Surplus/(Project Deficit)</b> | <b>(\$87,592)</b>                              | <b>\$2,408</b>                        | <b>(\$90,000)</b>                                       |

Notes – 1. BYD budget includes 10% contingency

Vehicle Costs

Staff recommends Board approval for a purchase agreement with BYD for \$684,341 per bus, with an additional allowance of 10 percent to cover the final vehicle options and specifications. The maximum vehicle purchase cost will be \$1,514,614 (Table 1). Additional project costs outside the BYD contract include procuring and installing Automated Vehicle Location (AVL) equipment and fare collection equipment, vehicle inspections and monitoring during the vehicles build, and staff and contractor project support.

As part of the regional Transit Capital Priorities (TCP) process, Marin Transit has \$1.19 million in Federal Transit Administration Section 5307 funds for the vehicle purchase. These are matched by \$261,360 in Measure A sales tax funding for transit capital projects. The Bay Area Air Quality Management District allocated another \$135,022 through a grant for Heavy Duty Zero Emission vehicles. Through its Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project, CARB will provide the vehicle manufacturer with a voucher for \$111,000 per vehicle, which reduces Marin Transit's vehicle purchase price.

The table below compares costs of electric, hybrid, and diesel only buses to better understand the projected full cost for the project.

**Table 3: Comparison of Vehicle Costs by Fuel Type**

|                                     | BYD 35ft Electric | Hybrid 35ft       | Diesel 35ft      |
|-------------------------------------|-------------------|-------------------|------------------|
| Vehicle Cost (12 year lifecycle)    | \$ 690,000.00     | \$ 736,000        | \$ 492,000       |
| Infrastructure Cost (20 years)      | \$ 200,000.00     | \$ 0              | \$ 0             |
| Projected Annual Mileage*           | 32,850            | 32,850            | 32,850           |
| Projected Fuel Economy (m/kWh, mpg) | 2.70              | 4.5               | 3.9              |
| Projected Fuel Cost/Mile            | \$ 0.50           | \$ 0.66           | \$ 0.76          |
| Projected Fuel Cost/year            | \$ 16,425         | \$ 21,535         | \$ 24,848        |
| Projected Maint Cost/Mile           | \$ 0.71           | \$ 0.71           | \$ 0.84          |
| Projected Maintenance/year          | \$ 23,324         | \$ 23,324         | \$ 27,594        |
| <b>Projected Total Yearly Cost</b>  | <b>\$ 107,249</b> | <b>\$ 106,192</b> | <b>\$ 93,442</b> |

\*Hybrid and diesel vehicles are not limited by range and likely travel further

#### Capital Infrastructure Costs

In addition to the vehicle purchase, infrastructure improvements will be needed to install the vehicle charger. These costs will depend on which of Marin Transit's contractors is selected to operate the vehicles and the final specifications for the improvements. Marin Transit is working with two contractors to ensure their sites can accommodate electric vehicles, and develop cost estimates for the charger's dedicated electrical service. These improvements will prepare the operations facility for future electric vehicle charging, regardless of vehicle manufacture.

Preliminary cost estimates for the infrastructure improvements are \$150,000-\$200,000, depending on location and extent of improvements. Marin Transit anticipates using the \$75,000 of Measure B funds that TAM allocated to the bus purchase for the infrastructure improvements. Staff is working to identify additional funding, finalize the charging location, and refine the infrastructure budget, and anticipates bringing a site selection and final budget amendment to your Board for approval in early 2017.

#### Maintenance Costs

Marin Transit estimates maintenance costs to be similar to maintenance of a Hybrid vehicle. While the cost of fueling with electricity is projected to be less than the cost of diesel, electric buses will be limited by range of miles they can travel daily. Similar to the Hybrid vehicles, staff estimates maintenance costs will be \$0.71 per mile, compared to \$0.81 per mile for a traditional diesel vehicle. Vehicle manufacturers expect maintenance costs to be lower due to no maintenance costs associated with the engine components. However, the technology is

relatively new. Actual costs to repair technical failures have not been established and will be monitored throughout the pilot project. For budgeting purposes, Marin Transit has chosen to be conservative in its estimates.

### Energy Costs

Choosing the appropriate electrical rate plan structure is critical to ensuring the District receives the most competitively priced power. Peak pricing and demand charges can greatly increase electric rates. Charging buses slowly, overnight will result in the lowest cost per kilowatt-hour (kWh).

Peak pricing is charged based on time of day or season when the power grid is most strained and can be two to three times the base power rate. The highest prices are typically during the daytime and in the summer. Some rate structures also include demand charges during peak pricing on top of regular usage charges. Demand charges are five to ten dollars for each kilowatt of energy used during this period, and can increase the cost of electricity by a large factor depending on how much energy is pulled. Bus chargers pull 80kW of power. Demand charges for an electric bus could range from \$400 to \$800 per day.

While the District plans to charge buses only during off-peak times at night, staff will try to choose a rate structure with low or no demand charging in case the buses need charging during the day. MCE has been instrumental in helping Marin Transit to understand electric pricing structures. Unless a location prohibits it due to an existing electrical service contract, the new vehicles will use MCE energy to power the zero-emission vehicles.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Anna Penoyar', written in a cursive style.

Anna Penoyar  
Capital Analyst

Attachment A: Vehicle Description  
Attachment B: Fast Charge vs. Slow Charge  
Attachment C: Letters of Support  
Attachment D: Electric Bus Manufacturers Comparison

## 2 - 35ft BYD K9S Low-floor Transit Bus



### Vehicle Facts

**Useful Life:** 12 years

**Battery:** BYD, Iron-Phosphate, 270kWh

**Passenger Seating:** AMSECO Insight (32 seats)

**Fareboxes:** GFI 36" High Odyssey

**Clipper Regional Fare System Reader:** One mounting location

**Surveillance Cameras:** Seon Explorer TX8, (6) Color Cameras

**AVL:** Syncromatics with Voice Annunciator

**Destination Sign:** Hanover 100% Amber LED

**Wheelchair Ramp:** Lift-U, LU-18, front door

**Wheelchair Postions:** 2

**Bicycle Rack:** Sportworks, 3 position

### Project Timeline

- **October 6, 2016: Purchase Options transferred**
- **November 21, 2016: Board Approval, Order Issued**

- January/February 2017: Pre-Production Meeting (Specs Finalized)
- **September 2017: Estimated Vehicle Delivery**





## Fast Charging



### Advantages

- Battery can be fully recharged in 5 minutes
- Buses can be used for longer periods of time with constant charging en-route

### Challenges

- Buses have shorter ranges (~50 miles)
- High voltage charging, resulting in demand charges and high electricity costs
- Additional infrastructure needs to be installed on a route

## Slow Charging



### Advantages

- Buses have a longer ranges (>100 miles)
- Charging can be planned for off-peak times when electricity pricing is lower
- Less electricity is pulled at one time, reducing electricity charges

### Challenges

- Limited to how long a bus can run on one charge



10/10/2016

Dear President Sears,

It is my pleasure to write this letter in support of Marin Transit's Electric Bus Pilot Project. This project was initiated in 2014 when Marin Clean Energy (MCE) approached the Transportation Authority of Marin (TAM) with a list of possible pilot projects that could help reduce transportation related emissions in the county. One of the proposed projects was an electric shuttle pilot. Since then, a small working group has been exploring this idea and Marin Transit recently announced that they were ready to move forward with this exciting project.

Marin Clean Energy sees electric buses as an opportunity to reduce local emissions and use the clean energy generated by MCE to further reduce overall emissions and lead by example. We look forward to continue assisting this working group with understanding electric rate structures and requirements associated with electric vehicles, and of course, exploring the possibility for this project to be funded on 100% local renewable energy via MCE's Deep Green rate.

Thank you for your leadership in regards to Marin Transit's Electric Bus Pilot Project. We look forward to continue working together to reduce greenhouse gas emissions within our community and being an inspiration beyond.

Sincerely,

A handwritten signature in blue ink, appearing to read "Beckie Menten", is written over the word "Sincerely,".

Beckie Menten  
Director of Customer Programs  
Marin Clean Energy  
<https://www.mcecleanenergy.org/>



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**Belvedere**  
James Campbell

**Corte Madera**  
Diane Furst

**Fairfax**  
John Reed

**Larkspur**  
Dan Hillmer

**Mill Valley**  
Stephanie Moulton-Peters

**Novato**  
Eric Lucan

**Ross**  
P. Beach Kuhl

**San Anselmo**  
Tom McInerney

**San Rafael**  
Gary Phillips

**Sausalito**  
Tom Theodores

**Tiburon**  
Alice Fredericks

**County of Marin**  
Damon Connolly  
Katie Rice  
Kathrin Sears  
Steve Kinsey  
Judy Arnold

October 28, 2016

Honorable Board of Directors  
Marin County Transit District  
3501 Civic Center Drive  
San Rafael, CA 94903

***Subject: Marin Transit's Electric Bus Pilot Project***

Dear President Sears:

It is my pleasure to write this letter of support for Marin Transit's Electric Bus Pilot Project. Transportation Authority of Marin Staff has been involved in the working group for the project since 2014, and we are excited to see the project move forward.

TAM is committed to bringing alternative fuel infrastructure and supporting alternative fuel vehicle education programs, and has budgeted \$75,000 of Measure B Alternative Fuel program funding towards the project. This will help cover any incremental cost of switching the vehicle type to electric and support necessary infrastructure upgrades required to support electric bus charging.

We look forward to staying involved in Marin Transit's Electric Bus Pilot Project and helping bring more zero emissions buses to Marin County in the future.

Sincerely,

A handwritten signature in black ink, appearing to read 'D. Steinhauser', is written over a faint, larger version of the same signature.

Dianne Steinhauser  
Executive Director

Cc: Nicholas Nguyen, TAM

Attachment D: Electric Bus Manufacturers comparison

|   | <b>BYD</b>                                     | <b>CCW</b>   | <b>New Flyer</b>  | <b>Proterra Quick Charge (FC)</b>  | <b>Proterra Slow Charge (XR)</b>   |
|---|--|--|---|--|--|
| <i>Lengths Available</i>                      | 30', 35', 40', 60'                             | ANY (retrofit of diesel bus)                               | 35', 40', 60'   | 35', 40'   | 35', 40'   |
| <i>Range</i>                                  | > 150 Miles                                    | 115 Miles  | 120 Miles   | 49-62 Miles  | 136-193 Miles  |
| <i>Battery Size</i>                           | 324 kWh  | 242 kWh  | 100-300 kWh   | 79-105 kWh   | 220-330 kWh  |
| <i>Charging</i>                               | Slow Charge                                    | Slow charge, plug in                                       | Rapid Conductive Charging (450kw) and Depot charging (100kw)                              | Fast Charge (High Voltage)   | Slow Charge - uses standard EV car charger (not included in purchase)      |
| <i>Costs</i>                                  | Base 35' Bus - \$690,000<br>Charger - included | New bus +<br>cost of electrification -<br>\$580,000        | Base Bus (300kWh)- \$950,000<br>Depot Charger - \$45,000<br>Inductive Charger - \$400,000 | Overhead Charging<br>infrastructure - ~\$100,000<br>Cost of electricity - much higher<br>due to higher loads in short<br>periods of time | Base 35' Bus - \$669,000<br>Charger - \$39,000<br>Total - \$708,000        |
| <i>Warranty</i>                               | 12 year battery                                | 1 year on bus, 5 year warranty<br>on Electric Drive system | 1 year on bus, 3 year on<br>battery   | 6 year, unlimited mileage,<br>offer extended warranty (50k<br>per vehicle)   | 6 year, unlimited mileage,<br>offer extended warranty (50k<br>per vehicle) |
| <i>Purchase to<br/>Delivery<br/>Timeframe</i> | 10 months                                      | 7 months   | 8-12 Months   | 18 months  | 18 months  |
| <i>Purchases from<br/>other Agencies</i>      | Soltrans, Sonoma, Stanford                     | Frederick County, MD                                       | Chicago (CTA)   | RTD, RTC, Foothill Transit   | Tri-Delta making a purchase,<br>no vehicles yet on the road                |

\*Gillig was also included in the evaluation, but they do not currently have an electric bus available.



# **Electric Vehicle Pilot Project**

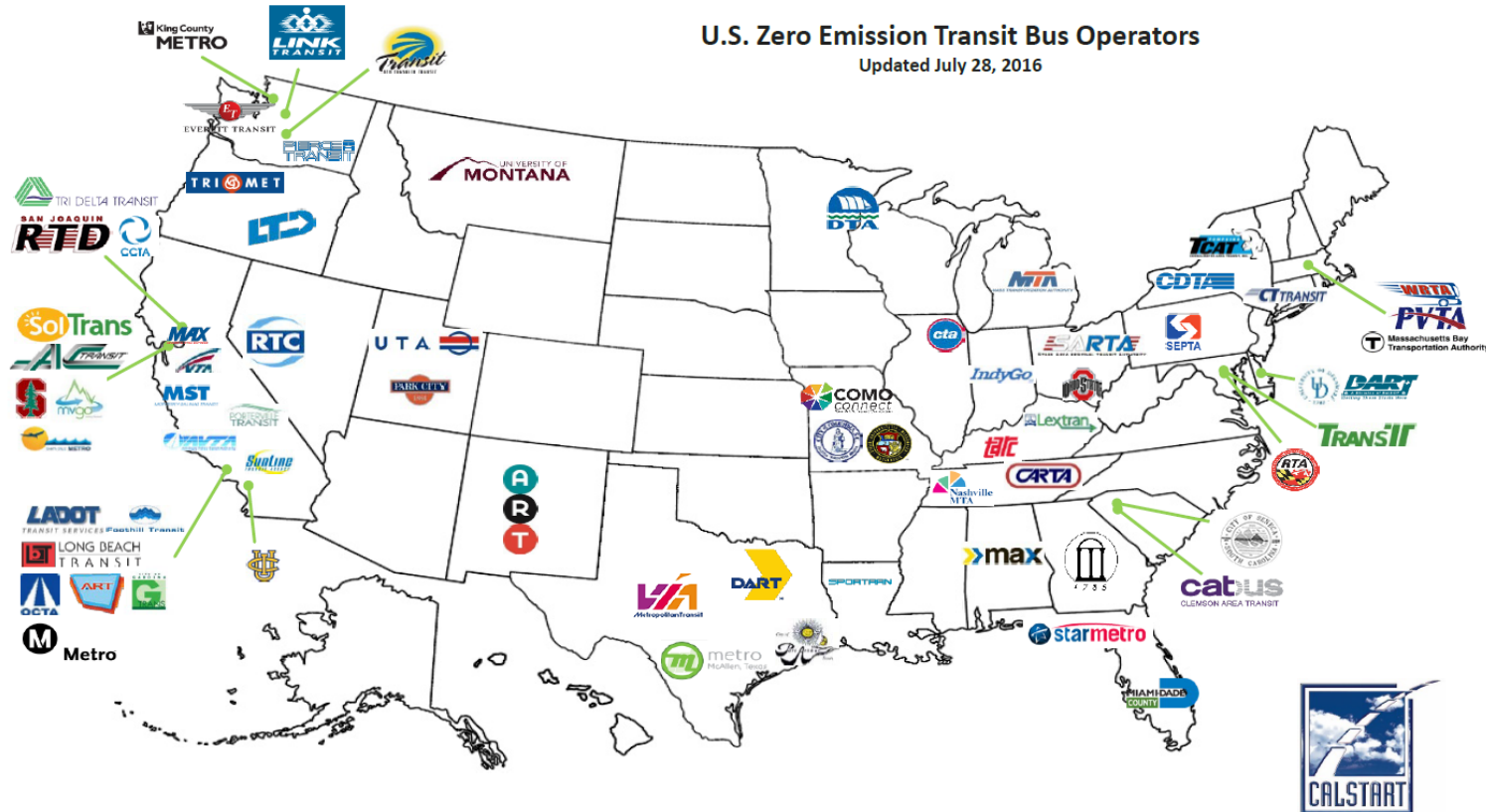
November 21, 2016

# Overview

- Background
- Vehicle Selection
- Project Evaluation
- Financial Impacts



# Zero Emissions Buses



- CARB working on a goal to have all Transit Fleets be zero emission by 2040
- Electric Vehicle pilot project listed in SRTP

# Working Group Partners



Marin Clean Energy providing support in understanding utility rates, and navigating energy needs



Transportation Authority of Marin providing funding opportunities.



Golden Gate Transit providing technical expertise.

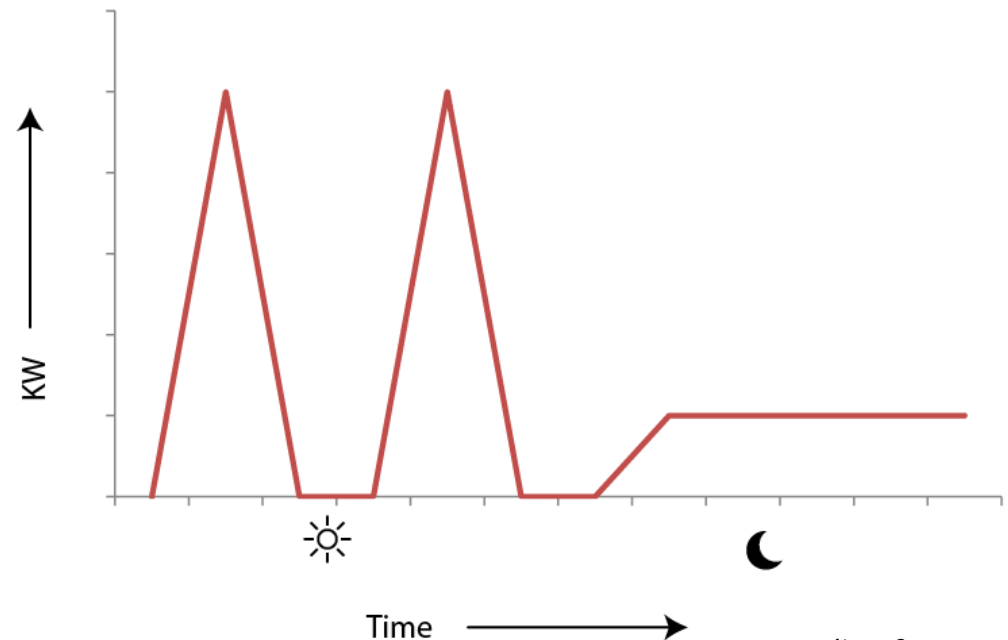


Marin Transit providing technical expertise.



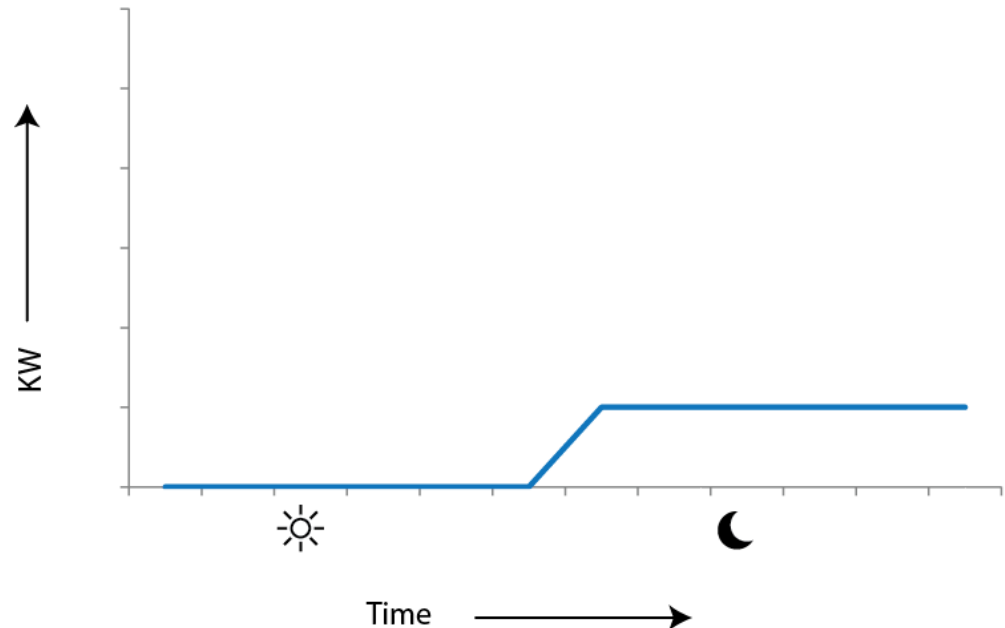
# Vehicle Selection – Slow Charge vs. Fast Charge

- Fast Charge allows vehicles to be in operation all day
- Ranges are shorter
- Extra infrastructure is required at bus stops or transit centers
- Expensive charging rates



# Vehicle Selection – Slow Charge vs. Fast Charge

- Slow charge allows vehicles to charge over night when electricity rates are less expensive.
- Limited by the range that it can operate in a day
- Additional infrastructure required only at depot



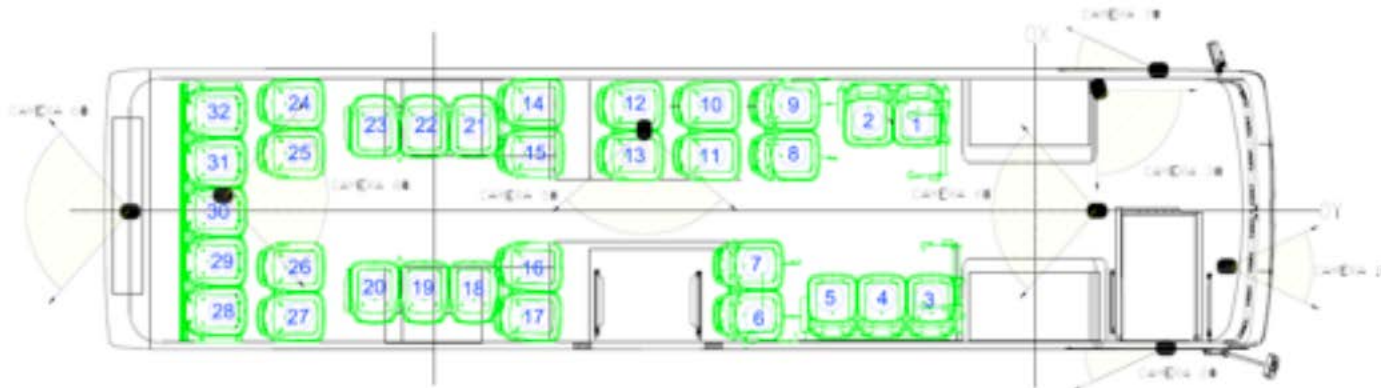
# Vehicle Selection – BYD – 35ft Electric

- 35 ft is appropriate for shuttle or “Big Bus” Routes
- Used by agencies similar to ours
- Delivery time 6-10 months from purchase order
- 12 year battery warranty



# Technical Specifications

- Length: 35.8ft
- Passenger seats: 32
- Wheelchair positions: 2
- Wheelchair Ramp: Lift-U, LU-18, Front door
- Bicycle Rack: 3 positions
- Top Speed: 62.1 mph
- Range:  $\geq 145$  miles
- Battery Type: Iron-Phosphate
- Battery Capacity: 270 kWh
- Charging Time: 3h-4h



- Performance**
- Outside Temperature
  - Range
  - Fuel Economy

- Reliability**
- Miles between road calls
  - Time out of service

- Cost**
- Electricity Costs
  - Maintenance Costs

- Scalability**
- How many routes are suitable for a typical EV range?
  - Are there locations where an on-route charger can be deployed?

# Fiscal Impact – Vehicle Types Cost Comparison



|                                  | BYD 35ft Electric | Hybrid 35ft | Diesel 35ft |
|----------------------------------|-------------------|-------------|-------------|
| Vehicle Cost (12 year lifecycle) | \$ 690,000.00     | \$ 736,000  | \$ 492,000  |
| Infrastructure Cost (20 years)   | \$ 200,000.00     | \$ 0        | \$ 0        |
| Projected Annual Mileage*        | 32,850            | 32,850      | 32,850      |
| Projected Fuel Economy           | 2.70 m/kWh        | 4.5 mpg     | 3.9 mpg     |
| Projected Fuel Cost/Mile         | \$ 0.50           | \$ 0.66     | \$ 0.76     |
| Projected Fuel Cost/year         | \$ 16,425         | \$ 21,535   | \$ 24,848   |
| Projected Maint Cost/Mile        | \$ 0.71           | \$ 0.71     | \$ 0.84     |
| Projected Maintenance/year       | \$ 23,324         | \$ 23,324   | \$ 27,594   |
| Projected Total Yearly Cost      | \$ 107,249        | \$ 106,192  | \$ 93,442   |

\*Hybrid and Diesel vehicles are not limited by range and would likely travel further

# Fiscal Impact – Vehicle Funding



BYD Purchase: \$1,514,614\*

Staff Time, Contingency, Vehicle  
Equipment: \$70,000

**Total Vehicle Purchase Estimate: \$1,584,614**

\$1,190,640 FTA Section 5307

\$261,360 Measure A

\$135,022 BAAQMD Grant

**\$1,584,614 Total Revenues**

\*After manufacturer rebate of \$111,000 per vehicle from California HVIP

Thank you

Anna Penoyar

Capital Analyst

[apenoyar@marintransit.org](mailto:apenoyar@marintransit.org)