

CORVALLIS AREA Metropolitan Planning Organization

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TECHNICAL ADVISORY COMMITTEE

Thursday, April 25, 2019

9:00 - 11:00 am

CAMPO Office, 777 NW 9th Street, Suite 204C

Corvallis, OR 97330

AGENDA

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| I. | <u>Call to Order</u> | Chair, Greg Gescher |
| II. | <u>Agenda Review</u> | Chair |
| III. | <u>Public Comments</u> | Chair |
| IV. | <u>Minutes of November 2, 2018, February and March Joint TAC</u> (Attachment A, B, C)
Chair
ACTION: Decision | |
| V. | <u>Electric Bus Study</u> (Attachment D)
<i>Review draft report</i>
ACTION: Decision | Nappa/Meltzer |
| VI. | <u>Regional Performance Measures</u>
<i>Discuss outcome of RTSP discussion from Policy Board meeting and begin conversation on performance measures</i>
ACTION: Discussion | Meltzer |
| VII. | <u>FY 2021-2024 TIP</u>
<i>Upcoming TIP process and discussion</i>
ACTION: Discussion | Meltzer |
| VIII. | <u>Updates</u>
<i>CAMPO Staff Report</i>
<i>Jurisdictional Reports</i> | Chair |
| IX. | <u>Adjourn</u> | Chair |

Meeting facilities are accessible to persons with disabilities. If you will need any special accommodations, please contact Emma Chavez at least 72 hours prior to the meeting. Emma can be reached at 541-924-84051. TTY/TTD 711

**CORVALLIS AREA METROPOLITAN PLANNING ORGANIZATION
TECHNICAL ADVISORY COMMITTEE
Friday, November 2, 2018
CAMPO Office, Corvallis**

DRAFT MINUTES

Members Attending: Greg Gescher, Gary Stockhoff, James Feldmann, and Rebecca Houghtaling

Members Absent: Barry Hoffman, Pat Hare, and Chris Workman

Staff: Phil Warnock, Nick Meltzer, and Emma Chavez

TOPIC	DISCUSSION	DECISION / CONCLUSION
I. Call to Order	The Chair, Greg Gescher called the meeting to order at 10:08 am.	
II. Agenda Review		There were no changes to the agenda.
III. Minutes of: September 28, 2018	Gescher provided handwritten clarification on minutes. The spelling of James Feldmann's last name needs to be corrected.	Consensus by the TAC to approve the September 28, 2018 meeting minutes with corrections.
IV. Policy on TIP Amendment	<p>Staff Nick Meltzer advised that the Policy on TIP Amendment was discussed at the last TAC meeting. Comments that were provided at the meeting have been incorporated.</p> <p>Members fell into discussion and made the decision to move Number 9. Scope changes including extension or shortening of a project to an Administrative Amendment.</p> <p>Rebecca Houghtaling moved to approve the Policy on TIP Amendment with update to number 9. Seconded by Greg Gescher. Consensus by the TAC.</p>	Consensus by the TAC to recommend the Policy on TIP Amendment to the Policy Board.
V. NACTO/Oregon APA/OMUG Debrief	<p>Meltzer summarized the lessons learned from attending the National Association of Transportation Officials (NACTO) conference, as well as the Oregon American Planning Association (OAPA) conference.</p> <p>Meltzer stated that when he attended the NACTO conference he focused on attending the segments that were more non-design</p>	

	<p>oriented, in order to hear more viewpoints about why transportation matters.</p> <p>Major Takeaways:</p> <ul style="list-style-type: none">• The scale of what's happening in Los Angeles is much bigger than our region, but there are still lessons to be learned. They've had to become more efficient, nimble and proactive due to necessity, and we have the opportunity to do that as well.• New technologies are coming whether we're ready or not, and it's better to be ahead of the issue rather than reactive.• Cities are building projects more quickly and cheaply, while also evaluating their long term use• How can CAMPO build capacity internally and externally to set up our communities for success? Trainings, policy guidance and data collection <p>Additionally, he noted that there is interest from COG staff on whether the COG could become a NACTO member. Phil Warnock added that the ACT has never been asked to do something on a Regional level that would benefit both AAMPO and CAMPO. There may be a lot of leverage that can be brought in Regionally with a membership through NACTO and Regional requests to the ACT. Meltzer will explore the issue.</p> <p>Meltzer questioned if the City of Corvallis would be interested in a bikeway training if CAMPO sponsored it. Gescher stated that, they would.</p> <p>Meltzer also advised that when he attended the Oregon APA Conference, the City of Bend advised that they implemented a count system. Staff would like CAMPO to work on a count system there is interest. Meltzer went on to provide information on the different types of count mechanisms. Gescher stated that the city has discussed this</p>	
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	<p>previously, and would also be interested in moving this forward.</p>	
<p>VI. Updates</p>	<p>CAMPO Staff Report – ODOT performance measures have been a slow roll out based on MAP-21. MPOs are asked to accept ODOT measures or set their own measures. CAMPO accepted ODOTs Safety Measures, and now it needs to consider Pavement, Bridge, and National Highway performance measures. These measures need to be approved by November 16th. If CAMPO decides to adopt its own measures, it would need to collect and report its own data.</p> <p>Houghtaling questioned if ODOT is collecting data on the non-interstate highways. Meltzer noted that it's on the national highway system (NHS). In reference to the local arterial collector, they are all part of the NHS. James Feldman got online to verify that arterial collectors are in fact part of the NHS.</p> <p>Meltzer went on to advise that Tarah Campi the AAMPO lead staff has moved to California and is contracting with the COG. A full time Transportation Planner and an Assistant Planner positions have been posted. The Transportation Planner will be taking Campi's place and the Assistant Planner will assist the MPOs.</p> <p>Benton County – The County now has a Facilities Manager. STIF Committee work continues and will be discussing funding at its meeting on Monday. Is also working on extending its dial a bus contract. A draft of the TSP has been received. It is scheduled to be approved in February of 2019.</p> <p>City of Corvallis – The TSP is in its final draft and will be reviewed this month by both the Planning Commission and planning hearing. The Planning Commission will make a recommendation and the City Council will hold a public hearing. The TDP will be ready when the City begins applying for STIF funds. The City has gone through interviews for the Bike and Ped Coordinator. There is someone the city is interested in. Lastly, there was no strike and on Monday the City Council will ratify the new contract.</p>	

	<p>OSU – Has a new Landuse Planning Manager. He’s responsible for the landuse planning coordination regarding and will be working with the City and County. OSU has also wrapped up its Transportation Plan which is not subject to the Transportation Planning Rules. Therefore the document is more of a vision, rather than a plan. A final version is set to be received by end of week. The University is starting a physical development strategy, an 18 month planning project. The Universities Transportation Plan will assist in the development of this strategy. Lastly, Houghtaling reported that there is a Scope of Work (SOW) for Washington Way and they have awarded a contractor to do the design work. The first phase will begin in November.</p> <p>ODOT – Has a consultant on board for the Van Buren project. The Hwy 20 Safety improvement project is also getting a consultant on board soon. Granger and Independence are priority intersections. There was question on the Hwy 20/34 between Corvallis and Philomath and recognizing large truck traffic and giving a priority through movement. Feldmann did not have that information.</p> <p>OCWCOG – Phil Warnock reported that applications have been received for the Planner and Assistant Planner positions. He noted that there are promising candidates to be interviewed.</p> <p>The Electric Bus Study is moving along. Staff has interviewed all the providers in the state that currently use electric busses or are implementing them. There is a break between large and small providers. Smaller providers are seeing electrification as the future and are going ahead with implementation of electric vehicles with a small fleet. Larger providers are taking their time studying electrification. Houghtaling suggested that CAMPO may want to explore testing an electric bus on campus.</p>	
<p>VII. Adjournment</p>	<p>The December meeting falls during the holidays therefore staff will reschedule the meeting via email.</p> <p>Meeting adjourned at 11:45 am.</p>	

**CORVALLIS AREA METROPOLITAN PLANNING ORGANIZATION
TECHNICAL ADVISORY COMMITTEE
Friday, February 28, 2019N
CAMPO Office, Corvallis**

DRAFT MINUTES

Members Attending: Greg Gescher, Gary Stockhoff, James Feldmann, and Rebecca Houghtaling

Members Absent: Barry Hoffman, Pat Hare, and Chris Workman

Staff: Phil Warnock, Nick Meltzer, and Emma Chavez

TOPIC	DISCUSSION	DECISION / CONCLUSION
I. Call to Order	The Chair, Greg Gescher called the meeting to order at 10:08 am.	
II. Agenda Review		There were no changes to the agenda.
III. Public Comments		
IV. Minutes of November 2, 2018		A quorum was not met and the minutes were tabled for the next meeting.
V. ADA Design Training	Staff Nick Meltzer advised that issues of ADA keep coming in conversations with ODOT and FHWA. In an effort to be proactive, both CAMPO and AAMPO have offered to sponsor ADA Design trainings in order to help support member jurisdictions. This would include TAC members and a designee.	
VI. Electric Bus Study	<p>Oregon Cascades West COG staff, Stephanie Nappa provided a brief summary of the feasibility study.</p> <p>Nappa advised that the study shows that electric busses in the City of Corvallis would be feasible. She stated that the type of electric fleet would need to be determined and the study advises on the different types, and their cost. The study also stakeholder interview summaries, the City of Corvallis needs and challengers, as well as potential funding sources.</p> <p>Meltzer noted that the role of CAMPO is to advise the City based on</p>	<p>Additional comments on the feasibility study are due to Meltzer by next week.</p> <p>Staff will compile the TAC and Policy Board comments and provide a final draft to the TAC at their March meeting for recommendation for</p>

	<p>the study, however, it is up to Corvallis on how to move forward.</p> <p>Members fell into discussion and provided the following feedback:</p> <ul style="list-style-type: none"> • Provide a table of CTS route range, traffic, hills, and climate • Schedule a demo <ul style="list-style-type: none"> ○ Make sure similar to the City of Corvallis <p>Meltzer advised that the big takeaway from those doing this locally is that if you will do it, commit staff time to do it in order to not have manufacturing issues.</p>	<p>approval to the Board at their April meeting.</p>
<p>VII. Regional Performance Measures</p>	<p>Meltzer advised that at the February Board meeting, representatives of ODOT and DLCD provided details of the RTSP requirements now that local TSPs are wrapping up. Meltzer noted that there are three options moving forward: (1) wait until legislation is passed, (2) wait until after the legislative session to see what the rulemaking committee will be working towards in regards to the climate, and (3) still move forward with performance measures at the local level.</p> <p>Staff's recommendation was to work with each jurisdiction to determine performance measures that work for them and then bring them to CAMPO to see if everyone is moving in the same direction. The Board met consensus on this recommendation.</p> <p>At the Board meeting in March, members will discuss how the process got to this point, and then move to performance measures. Staff will provide a debrief and follow up to the TAC.</p> <p>When asked, Meltzer clarified that the performance measures indicate that if the TSP does not meet the 5% VMT reduction over the planning period, the MPO has to develop alternative measures. Mode sharing is an example of alternative measures.</p>	
<p>VIII. Updates</p>	<p>a) CAMPO Staff Report The UPWP review by FTA, FHWA, and ODOT is scheduled for tomorrow, March 1st. Staff has received comments from OSU, ODOT, and Corvallis.</p>	

	<p>CAMPO and AAMPO staff are working on a Joint TAC meeting to discuss Regional projects. Regional Park & Ride Project, Loop, and possible Regional Project.</p> <ul style="list-style-type: none"> • Customer Focused Training and Travel. The COG will serve as the central, one click, one call transit resource in the Lincoln, Benton, and Linn region. The tasks include: 1) training transit drivers on assisting riders with mobility issues; 2) training riders on how to use the bus; 3) acting as the centralized call line for assisting with trip planning for the general public; 4) developing a mobile ticketing application such that people can travel on all transit within the three counties using one ticket, and one mobile application. • 99W Corridor Mobility Pilot. Currently, there are gaps in transit service along 99W. Lane Transit District serves from Junction City south, Benton County Transit serves from Corvallis to Adair Village, and Cherriots and Yamhill County serve from Monmouth north. We plan to conduct a 9-12 month planning study to evaluate what type of service and when it should run, and then operationalize that pilot for between 12 and 18 months after that. Our hope is connect the small communities along 99W with the larger urban areas. <p>b) Jurisdictional Reports</p> <ul style="list-style-type: none"> ○ FlixBus – Looking at connection between UO, OSU, and Portland ○ Corvallis – have adopted their TSP. Josh Capps is the new Bike and Ped Coordinator. Applications for discretionary funds have been submitted. 	
IX. Adjourn	Meeting adjourned at 9:45 am.	

**AAMPO-CAMPO Joint TAC Meeting
TECHNICAL ADVISORY COMMITTEE (TAC)
MINUTES
Thursday, March 14, 2019**

Members Present: Chuck Knoll, Darrin Lane, Walt Perry, Chris Workman, James Feldmann, Barry Hoffman, Gary Stockhoff, Mark Bernard, Greg Gesher, Georgia Edwards, Janelle Booth, Greg Jones

Guest Present: Patrick Wingard (phone)

Staff Present: Nick Meltzer, Dana Nichols, Steph Nappa, Phil Warnock

1. Call to Order and Agenda Review

Staff Nick Meltzer called the meeting to order at 1:34 pm.

Introductions were conducted.

2. Public Comment

There were no public comments.

3. Park & Ride Study Presentation

OCWCOG Staff Stephanie Nappa presented an overview and history of the Park & Ride Study. The presentation included a park & ride inventory, needs analysis, best practices, recommended sites, and implementation strategy. She requested input from the joint TACs regarding park & ride locations not listed on the map. Darrin Lane pointed out the Millersburg location that may not be a formal park & ride, but is used frequently. Walt Perry also pointed out the Ankeny Hill location. Steph explained that those listed are only official ODOT designated lots, though there are others that COG has identified as well. She will get clarity about whether or not ODOT will formally identify these locations as park & rides.

Chuck Knoll asked for clarification about whether these are specifically for transit. Nappa explained that while some lots are used for transit, others are geared more towards carpooling. Knoll pointed out another location in Lebanon that could be considered. Nappa agreed, stating that survey results showed that Lebanon was a popular location for both current use, and for potential expansion.

Meltzer asked Chris Workman of Philomath if there is heavy use of park & rides in Philomath. Workman explained that there are two locations that are used now, though they are not official locations. Nappa stated that if need be, we could look into changing the official location in Philomath. Workman said that was likely unnecessary, as there was plenty of parking at the current location at the library/city hall.

James Feldmann asked if the report shows which locations have transit stops. Nappa explained that most locations are used for carpooling or recreational activities, and transit is not identified on current maps. The plan will show park & ride amenities, which will include transit stops in addition to other useful or nearby features.

Some concern was brought up about the existing location in Albany that's near to an adult store. The existing location is also used for HUT, so there may need to be some additional research about the best location to serve all purposes. Barry said that the HUT shuttle may

no longer pick up from that location, but rather from the Comfort Suites. Parking costs \$2/day.

Nappa presented the evaluation criteria for the existing and future park & ride location, and asked for TAC feedback. Perry stated there's a location that's on and off the freeway in Albany that should be considered.

Meltzer questioned if 'number of commuters' is a good criterion with which to evaluate based on the location factors of rural v. urban. Percentage might be a better way to go. Workman suggested also looking at distance between locations. Meltzer also asked if proximity to scenic bike trails has been part of the criteria. Hoffman suggested looking at if the site is lighted/can be lighted.

Feldmann questioned what the purpose of selecting them are. Nappa explained that they will prioritize potential sites that will eventually be improved or invested in the future.

4. Regional Transportation Overview

Meltzer discussed history of regional planning efforts started by him and Tarah.

Nichols introduced the memo that described current AAMPO/CAMPO projects and potential projects that staff could work on moving forward.

Group discussion ensued on which projects the group has interest in collaborating on moving forward.

OCWCOG is hosting a bikeway training, bringing national experts to help staff boost their knowledge to implement bike elements of TSPs.

Chuck Knoll discussed a bike path that was started and the need for phase 2 of funding from LBCC to OSU. Knoll also talked about the Hwy 20 bike path or extending a bike path along the railroad connecting to Lebanon along Hwy 20. Meltzer asked if the bike paths were in the TSP, Knoll responded they were. Darrin Lane brought up the issue of property owners that aren't used to having the public traversing their property makes regional bike paths difficult.

Feldmann asked if the goal was to identify projects for staff to work on, or projects to just discuss and coordinate on as a region. Meltzer and Nichols responded they are looking for both, queued up the idea of joint AAMPO/CAMPO planning.

Knoll brought up the idea of a multiuse path along the rail crossing in Albany connecting Calapooia brewing to the golf course in North Albany, said that would be a really impactful project.

Phil Warnock discussed the idea of innovative thinking with OCWCOG staff to take advantage of the upcoming funding, looking to national examples of regional projects, and expressed excitement about the list of potential regional projects. Warnock stated that Federal partners want to see more regional collaboration and were happy about this reflected in UPWPs

Warnock discussed upcoming bike/ped funding (ConnectOregon) parameters are being developed to determine funding structure. There will be an emphasis on community connections and longer paths to provide for options other than driving. Safe Routes to School could also connect into this work and funding opportunities are on-going (infrastructure and non-infrastructure).

Gary Stockhoff brought up the need to include freight planning/mobility in MPO efforts, didn't want freight to be forgotten. Feldmann discussed the freight components in Corvallis, Philomath, Benton County TSPs.

Walt Perry discussed the issues in Jefferson and the lack of safe bike routes in his community, especially along 164. People currently walk and bike along this road and the facilities suddenly stop going through Jefferson. Perry also discussed the safety concerns going across the bridge. Lane added a multiuse path from I-5 to Jefferson would be pretty feasible, just would require planning (siting and environmental issues), and added it's just as important as Hwy 20 and may be more feasible to actually get done.

Knoll brought up the ODOT bridge section and their efforts to evaluate bridges for seismic soundness and updating DOGAMI hazard areas. Brought up the idea of adding bike/ped facilities as they do these seismic upgrades. Setting up a meeting for Linn County (wants to include Albany) to figure out all the emergency routes etc. Contact Bruce Johnson to discuss the effort for Benton County.

Meltzer suggested a regional connectivity study (freight, bike, transit).

Lane brought up the MPO regions and their shared commute shed, asked if places like Lebanon (which aren't in MPO but are part of the commute shed) could be included. Meltzer/Nichols said yes. Warnock added that OCWCOG can function as the regional boundary to do these types of studies and include areas outside the MPOs specifically.

Feldmann brought up the issue of interchanges for freight, and asked what the equivalent of "system gaps" seen in bike/ped connectivity is for freight. Marc Bernard responded with interchange area management plans for the State system, and added the relationship to safety on Hwy 34 and how excessive business access to system directly creates uncertainty and conflict points for drivers. Discussed history of state action of first limiting biz access "excessively" that got major pushback from biz community.

Chris Workman brought up Philomath issues of freight safety along Hwy 20 and how it has limited growth of downtown and impacted safety. Plans are in place but there hasn't been implementation. Expressed concern that more planning doesn't help (though they could be updated maybe) wants to actually implement changes. Issues have arisen since the couplet was put in, have more freight traffic and makes people avoid downtown. Bernard added that biz generally don't want bypasses because they think all the traffic will skip them, Stockhoff brought up a successful example of a bypass which allowed downtown to thrive. Discussion of this same issue in other communities. Perry brought up that it just depends on the type of traffic that generally goes through town.

Meltzer brought up the idea of addressing freight vs downtown conflicts, Warnock added the idea of creating strategies for implementing improvements to limit conflicts. Bernard added the idea of pilot treatments to see what type of street treatments can create most benefit given existing infrastructure.

Workman expressed that his favorite part of AAMPO/CAMPO is providing project support when funding comes up.

General consensus that joint TAC meetings are useful. Nichols suggested meeting twice a year, once in each jurisdiction. There was no disagreement to this idea.

Nichols brought up the ADA discussion, it is tabled for next joint meeting due to turnover at ODOT.

Knoll brought up the idea of a regional bike route map, thinks it would be useful to support increased investment for new facilities to fill gaps – general consensus that it would be useful. Question about how to get that info onto Google. Lane suggested adding it to a web interface for a mobile app for route planning, Feldmann wanted it open source so it could be used for any desired purpose. Knoll added points of interest could pay to get added to the map.

Warnock brought up staff effort around data visualization that will hopefully get tackled in 2019, said staff will be asking for TAC input on those.

There was a request for scope of work on bike route map/connectivity plan. Suggested the inclusion of proposed projects in local TSPs and adding those to the map to see what gaps are left.

Knoll wants to have a better way to determine future freight needs/population growth needs given the fast growth the area has been experiencing. Thinks current projections are inadequate.

Lane requested a timeline of big reporting/planning requirements so the group understands what capacity is for these other regional planning projects.

Idea raised for MPO traffic counting project, supported by Lane, other nods around the table.

5. Calendar of Future Joint TAC Meetings

Consensus was met to hold biannual joint TAC meetings, alternating AAMPO and CAMPO locations.

6. Adjournment

Meeting adjourned at 3:10 pm



CORVALLIS AREA Metropolitan Planning Organization

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MEMORANDUM

DATE: April 18, 2019
TO: CAMPO TAC and Policy Board
FROM: Stephanie Nappa and Nick Meltzer
RE: **Battery Electric Bus Feasibility Study**

This memorandum evaluates the feasibility of utilizing battery electric buses in the Corvallis Transit System. It includes potential costs, social benefits, and a summary of technology decisions for Corvallis to consider.

Introduction

Electric Buses are becoming increasingly popular in transit fleets across North America, and the world. Transit providers in Los Angeles, Seattle, and Vancouver, BC have pledged to purchase exclusively zero emission vehicles starting in 2025. Furthermore, electric buses are currently being tested in Washington, DC, Park City, Utah, Chicago, Louisville, KY, Albuquerque, NM, and Portland, Oregon. The technology is evolving exponentially, the market is expanding and a new US manufacturing sector is under development.¹

But what does this mean for Corvallis? What differences exist between their transit system and those listed above? Does it make sense to invest now in electric buses?

The Corvallis Area MPO previously examined the feasibility of compressed natural gas (CNG) buses for Corvallis Transit System. During the review of the study, the community provided feedback that the life cycle impacts of CNG are not environmentally friendly due to the processing methods for the gas, primarily extraction through fracking. The evolution of this discussion is the starting point for this study. Specifically, the 2018-2019 Unified Planning Work Program, from which the Corvallis Area MPO's work is guided, has the following description:

330 – Feasibility Study of Electric Buses for CTS

Purpose

The purpose of this study is to identify the logistics, the costs and the benefits of an environmental-friendly energy source for CTS buses.

Description

In the past CAMPO studied the feasibility of converting the existing CTS diesel buses to Compressed Natural Gas (CNG), which is a cleaner fuel. The study examined the costs, logistics and the Return on Investment (ROI) for purchasing CNG buses compared to retrofitting the existing fleet. The conclusion of the study pointed to the fact that the current method of extracting

¹ Roberts, David "Electric buses are coming, and they're going to help fix 4 big urban problems." Vox. April 28, 2018

CNG, known as fracking, is harmful to the environment and due to this extracting practice, CNG is no longer considered an environmental friendly energy source. Therefore, the next phase of this study will be exploring the benefits, the cost and the logistics of using electric buses. The study will be conducted with assistance from the Oregon Department of Energy and in consultation with the City of Corvallis. Activities under this task will include:

- *Data collection on the environmental benefits of electricity as a source of energy and its comparison with diesel and CNG;*
- *Estimation of the costs, identification of grant opportunities for covering the cost;*
- *Identification of needed charging facilities and charging logistics.*
- *Programming fleet renewal and replacement plan, calculation of Return on Investment.*

Product

A report that provides necessary information for making decision on the conversion of the fleet to electric buses.

Glossary

BEB: Battery Electric Bus

NREL: National Renewable Energy Laboratory

CNG: Compressed Natural Gas

DGE: Diesel Gallon Equivalent. A term used to compare the fuel efficiency of electric buses with conventional diesel buses

LONO: Low Or No Emissions, used to describe low emissions transit vehicles as well as a specific Federal Transit Authority Grant for electric bus replacement.

MBRC: Miles Between Road Calls, a term used to describe how often a vehicle is in maintenance

Slow Charge: Bus charging method which uses a plug-in station and typically takes 4-6 hours for a full recharge. Also called depot charge or plug-in charge.

Fast Charge: Bus charging method which uses overhead or wireless charging and typically takes 10-15 minutes for a full recharge. Also called on-route or in-route charge.

Literature Review

To obtain a better understanding of electric buses, their current use in the United States, and existing information on their implementation, staff reviewed current literature on electric buses. Gathered via internet sources, the literature includes articles from general interest news sites as well as peer reviewed papers and articles from research centers across the country.

Eudy, et al. *Foothill Transit Battery Electric Bus Demonstration Results*. National Renewable Energy Laboratory, 2016.

Sponsored by the National Renewable Energy Laboratory (NREL) and in combination with the California Air Resources Board (CARB), this study compared battery electric buses (BEB) with buses operated on compressed natural gas (CNG) for the Foothill Transit District, located in Los Angeles County. The evaluation spanned 14 months and the operating cost, availability, overall usage, fuel economy, and maintenance needs were compared. While the buses were utilized on

different routes, the BEBs has lower maintenance costs, much better fuel economy, the same availability, and similar maintenance intervals. One challenge noted on distance between charges involved the length of time idling in traffic as the bus requires a minimum amount of energy to maintain climate conditions and lighting needs. It should also be noted this study was exclusive to one manufacturer of BEBs.

Federal Transit Administration. *King County Metro Battery Electric Bus Demonstration—Preliminary Project Results*. US DOT, 2017

The National Renewable Energy Laboratory completed a third party evaluation as part of a Federal Transit Administration TIGGER grant in 2010. King County Metro purchased three Proterra 40' Catalyst Battery Electric Buses. Proterra was chosen due to comprehensive test period with a leased bus. King County Metro drove 32,000 miles over 106 days and operated 24 hours a day, covering 325 miles, across an 18.6 mile route. The test also involved rapid charging infrastructure at a Park and Ride, where the bus has a layover.

The analysis compared battery electric buses with diesel and diesel hybrid buses, as well as an electric trolley. FTA uses Miles Between Road Calls (MBRC) as a measure of reliability. With a target of 4,000 MBRC, the battery electric buses at King County Metro had 2,433 MBRC, which is both below the target, and significantly below the hybrid and diesel MBRC, of 10,009 and 14,699, respectively. In terms of energy use, the study converted electricity to miles per diesel gallon equivalent (mpdge). The BEB averaged 16.7 mpdge, compared to 6.4 and 5.4 mpdge for the hybrid and diesel buses respectively. Though the electric buses have better fuel economy, fuel prices were twice as high on a per mile basis due to electricity time of use and demand charges. Maintenance costs over the study period were lower for the electric bus (\$0.18/mile), though the study noted this was because the vehicles were under warranty and most of the maintenance was covered by the Proterra technician.

Transit Cooperative Research Program. *Battery Electric Buses – State of the Practice*. Transportation Research Board, 2018.

Sponsored by the Federal Transit Administration and the Transit Development Corporation, this synthesis report provides a comprehensive analysis of BEB deployment considerations including planning, procurement, infrastructure, operations, and maintenance. The report included a literature review, a summary of current BEB deployment in the US, a survey of 18 transit agencies operating BEBs, and five case examples.

Results showed that extensive planning and analysis in partnership with stakeholders was critical to successful BEB deployment. Selecting the appropriate battery size, charging infrastructure type and location, and electricity rate structure are dependent on the needs of each transit agency. Survey respondents recommended including maintenance staff, union representatives, utility providers, local government, and community organizations in the planning process to ensure the bus fleet and charging infrastructure will meet the long term goals of the transit agency.

Capital costs for BEBs are higher than for diesel or CNG buses, primarily due to the cost of the traction battery and the charging infrastructure. Most agencies used external funding to purchase their electric buses. Depending on local utility rate structures, energy costs were also higher for BEBs than for diesel buses for several agencies. However, the study noted that electricity rates are generally more stable than diesel costs which can be useful for budget forecasting. Fuel economy for BEBs is significantly higher than diesel or CNG buses, though driver training is important for achieving consistent fuel economy and ensuring sufficient operating time between charges. Maintenance costs have reportedly been similar to or cheaper than for diesel buses, though lead

time for parts is longer. It should also be noted that the relatively young age of BEBs in operation means none of the buses have needed a mid-life overhaul (i.e. a battery replacement), so the associated costs are yet unknown. The availability and reliability of BEBs is approaching that of conventional buses and the reliability of charging infrastructure has been excellent.

Overall, 12 of 13 agencies were satisfied with their BEB deployment, with 8 agencies stating they felt very positive. 86% of the agencies plan to purchase more BEBs in the future.

Levy, Alon. "The Verdict's Still Out on Battery-Electric Buses." CityLab²

This article describes the variety of challenges that North American transit agencies have experienced while testing BEBs in their transit fleet. The most common complaints included poor performance when the buses ran on hilly routes, in cold or hot weather, or got stuck in traffic. Most agencies found the battery range did not meet manufacturers' claims. Additionally, charging time posed challenges for route design, and often required the agency to use more buses to provide the same level of service as their diesel fleet. Overall, the agencies interviewed for the article think BEB technology is not ready to meet the demands of providing full day transit service. The article states this is why most European transit agencies have been hesitant to convert their own fleets.

It should be noted that the agencies included in the article have a service area much larger than that of CTS, and many experience weather conditions more extreme than Corvallis' relatively moderate climate. While the caution expressed by these agencies should not be overlooked, it conflicts with the findings from the 2018 Transit Cooperative Research Program report which described overall positive transit agency experience with BEBs. Experiences from Oregon transit providers that have tested BEBs are likely to more accurately predict BEB performance in Corvallis due to similarities in climate, terrain, and service area size.

Interviews

Staff interviewed transit providers across Oregon that are implementing, or planning to implement battery electric buses. This includes Tri-Met, South Metro Area Regional Transit (SMART), Lane Transit District (LTD), and Josephine County Transit (JCT). Summaries of the interviews are below, and full transcripts are available upon request.

The following findings are summarized from the interviews:

- **Investing in Electric Buses is Different for Small Versus Large Transit Agencies.** Larger agencies have more substantial concerns to address when it comes to electrifying their entire fleet. They require buses that can travel longer distances, over longer periods of time, and in turn, more charging infrastructure. In this sense both large agencies are spending more time on "proof of concept" as they think about rolling out electric buses for their entire fleet. On the other hand, the smaller agencies see battery electric buses as a way to save money and reduce maintenance over the long term while diversifying their fleet and preparing for future technology.

² <https://www.citylab.com/transportation/2019/01/electric-bus-battery-recharge-new-flyer-byd-proterra-beb/577954/> (accessed January 18, 2019)

- **Good Project Management of the Process is Vital.** If electric buses are to be implemented, one of the biggest recommendations is to insure there is an appropriate amount of staff time, or even an entire staff person, to dedicate towards figuring out all of the moving pieces, and insure the bus manufacturer is meeting approved standards during construction of the bus. Some agencies outsourced this to a consultant, which was included in their grant application
- **Charging Infrastructure is a Challenge in and of itself.** Determining which routes to run, the type of manufacturer to use, the impacts on maintenance costs and staff are all important considerations for implementing electric buses. However, charging infrastructure adds an additional level of complexity. Some manufacturers have proprietary chargers, there is slow vs. fast charging infrastructure, and significant impacts on electric costs, as well as considerations for how “green” the electricity is. Additionally, no one in the country has had to replace a battery in a bus yet.
- **Battery Electric Buses are New Infrastructure, and Many Unknowns Remain.** Diesel buses have been around for decades, and their technology is both well known, and refined over the years. Compressed Natural Gas technology, while newer than diesel, has also existed for more than a decade. In this sense, buses have gone through a complete life expectancy using either diesel or CNG. However with electric buses and electric bus infrastructure, no public agency has owned or operated one for the entire life expectancy of a bus. Batteries have not been replaced and the longest any agency has been running electric buses is seven years.

The following table includes a summary of the agencies interviewed, the manufacturer of electric buses they’re using, and the status of implementation.

Table 1: BEBs in Oregon

Transit Agency	Supplier	Bus Size	Charge Type	Status
Lane Transit District	BYD	40 ft	Slow Charge	Testing
Josephine County Transit	Complete Coach Works	40 ft	Slow Charge	Ordered
South Metro Area Regional Transit	Proterra	35 ft	Slow Charge	Ordered
TriMet	New Flyer	40 ft	Slow and Fast Charge	Ordered/Testing

Lane Transit District (LTD)

Lane Transit District invested in electric buses for two major reasons: 1) they serve a community where people care about greenhouse gas emissions and want to see investments in cleaner technology, and 2) they have an aging fleet and are looking to replace buses, especially those with a lower maintenance cost. They are experiencing a number of challenges including manufacturer reliability, locating and installing charging infrastructure, and determining route effectiveness.

LTD is currently piloting a 40’ electric bus from BYD, with 4 more on order once the first is accepted. Their current fleet consists of 82 vehicles at peak pull out, including multiple engine types and bus lengths. Mainly 40’ buses, LTD also runs 60’ articulated buses. All of their para transit vehicles are gasoline. LTD has had multiple issues with the quality of the buses they received from the manufacturer. Initially ordered in 2015, it took two years to receive three buses, all of which

had quality control issues. Those were sent back and the issues were fixed on the pilot bus they're currently testing.

Josephine County Transit (JCT)

Josephine County Transit decided to invest in electric buses to diversify their fleet and save money on both maintenance and fuel. The original motivation came from a private citizen who arranged for Proterra (a BEB manufacturer) to stop by and give a tour of their buses. This inspired their Transit Program Supervisor to examine the issue in more detail and when presented to the county commissioners, the proposal received broad based support due to the cost savings as well as environmental benefits.

JCT has 14 buses at peak pull out, of which 4 are standard 40' and the remainder are Class C cutaways (short bus). Part of JCT's transition to electric buses is they were in need of new buses and additional capacity. They are purchasing 2 vehicles from Complete Coach Works, which are remanufactured Gillig or New Flyer buses converted to electric. Complete Coach Works was chosen due to an existing state contract in Washington, which allows Oregon municipalities to purchase through their approved vendors. Furthermore, JCT chose Complete Coach Works because they use Gillig or New Flyer buses, which are buses first, and electric vehicles second, as opposed to some of the new manufacturers that are strictly electric vehicle manufacturers. This was the quickest way to get a new bus.

South Metro Area Regional Transit (Wilsonville)

South Metro Area Regional Transit (SMART) is the provider for the City of Wilsonville, but connects with the larger Portland Metropolitan system, and as such receives some funding from Tri Met. Interest in electric buses has been ongoing over the last couple years, as the city applied for FTA grants twice before receiving it on third try, in 2017. The new transit program manager sees electric buses as the natural progression of compressed natural gas (CNG), of which Wilsonville has been involved with for 10 years. He also is looking to diversify at the start however, and not going full electric.

They have 32 vehicles at peak pull out, which range from 40' conventional buses to 26' cutaways. Two thirds of their service is free, while routes that leave the city charge a fee. They are purchasing two 35' Proterra buses, along with infrastructure for charging. In addition to the buses and infrastructure, Wilsonville included the cost of a consultant in their application, provided preliminary route analysis, as well as provide quality control/assurance during manufacturing. The buses will likely go into service in May or June of 2019. They're using slow charge infrastructure on their lot, which they are currently working through.

TriMet

TriMet, the regional transit provider for the Portland Metro area, is currently testing an electric bus, with the expectation to receive four more once they have approved the first. After winning a LONO grant in 2016, TriMet received their New Flyer electric bus this year. A number of factors contributed to TriMet's desire to test electric buses, including community interest, pressure from advocacy groups, and the desire to explore new technology. More recently, TriMet's adopted long range plan includes a provision to convert their entire fleet to zero emissions, and use HB 2017 to start the transition. A conversion plan was developed in September 2018 which describes the

process of converting to BEBs by 2040 which involves a 5-year “trial phase” ending in 2023.³ In this sense, they are being very methodical about testing and implementing electric buses.

TriMet has 670 buses at peak pull out, and uses exclusively Gillig and New Flyer buses. Nearly all of their buses are diesel, with 9 diesel hybrids. They decided to use New Flyer primarily because of their relationship and history with the manufacturer. In terms of maintenance, TriMet is less concerned than other agencies due to the fact their technicians also work on light rail vehicles, so they are more comfortable with different vehicles. They have faced challenges with implementation, including delays and quality control issues.

TriMet’s conversion plan states that slow charge buses are currently the agency’s preferred technology, but a pilot project for Line 62 will test fast charge bus performance. This pilot involves a partnership with PGE, the local utility provider, in which PGE is responsible for the design, implementation, and maintenance of the fast-charge infrastructure. This reduced the infrastructure cost for TriMet and allowed them to purchase an additional bus instead.

Corvallis Needs & Challenges

Corvallis has 15 buses and one trolley, using 10 vehicles at peak pullout. Buses are 35’ Gilligs that operate 30,000 revenue hours and 445,000 miles annually.

Several CTS buses are in need of replacement in the near future. This creates an opportunity to begin transitioning the fleet to BEBs if Corvallis chooses to move forward. However, the Corvallis Transit Development Plan (2018) calls for increased bus service frequency on all routes which will require an additional bus within 10 years, and 9 additional buses within 20 years. The TDP assumed a diesel bus fleet and calculated costs accordingly. Switching to BEBs with higher capital costs will likely require additional funding or a change in the proposed improvements to service frequency.

Because Corvallis operates a fare-less transit system, annual revenue is not dependent on ridership. Thus, Corvallis does not face some of the challenges peer transit agencies will have to contend with due to the increased popularity of ride hailing and other transportation services that compete with public transit. This allows Corvallis to make investments with the benefit of near term revenue stability.

A key component of the transition to BEBs is the training of maintenance staff, drivers, and first responders. Corvallis directly employs maintenance staff, but drivers are a contracted service. Significant training on BEB operations and technical components will be necessary and new contracts and/or job descriptions may be necessary to accommodate changes to the work flow and responsibilities of both groups. First responders will also require training on how to safely engage with BEBs in an emergency event. Corvallis benefits from the Advanced Transportation Technology Center at Linn-Benton Community College which offers training and education for first responders and technicians.

³ TriMet. *Non-Diesel Bus Plan*. TriMet, 2018.

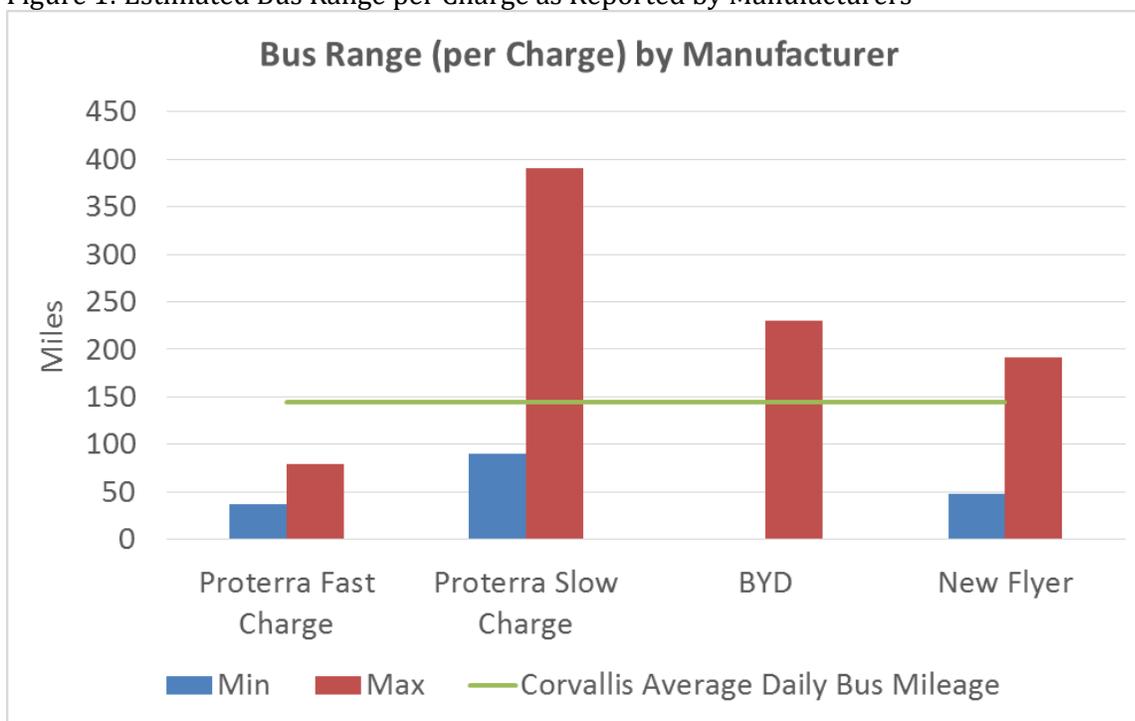
Table 2: Current Corvallis Transit Statistics⁴

Average Temperature	53°F
Average Temperature Range	33 - 83°F
Average Daily Bus Mileage	145 miles
Daily Bus Mileage Range	9 - 212 miles

Table 3: BEB Manufacturer Range Estimates

Proterra (Fast Charge)	37-79 miles depending on bus and battery size
Proterra (Slow Charge)	90 - 390 miles depending on bus and battery size
BYD 35 ft	230 miles
New Flyer 35 ft	48 - 192 miles depending on battery size
Gillig	Unknown
Complete Coach Works	Unknown

Figure 1: Estimated Bus Range per Charge as Reported by Manufacturers



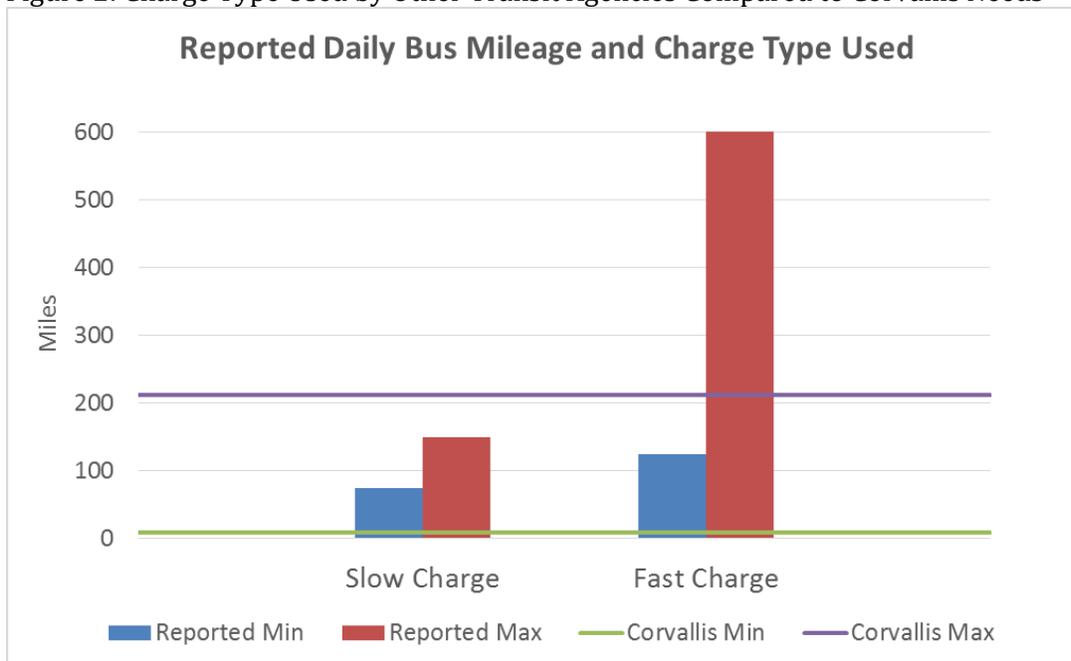
While the fast charge buses do not have sufficient range in a single charge to meet Corvallis’s average bus needs, fast charge buses are typically charged multiple times per day at one of their regular stops. Slow charge bus batteries typically need to be sized to accommodate a full day of driving on a single charge.

A study of current BEB operations in the United States included data from ten transit operators using electric buses, listing their daily bus mileage and the type of charge infrastructure those buses use.⁵ As shown in Figure 2, agencies with higher daily mileage tend to use fast charge technology as they can rapidly refill bus charge as needed throughout the day.

⁴ Does not include potential route changes specified in the Transit Development Plan

⁵ Transit Cooperative Research Program. *Battery Electric Buses – State of the Practice*. Transportation Research Board, 2018.

Figure 2: Charge Type Used by Other Transit Agencies Compared to Corvallis Needs



Proposed Cost

This section summarizes potential the potential costs of vehicles and associated infrastructure, in addition to providing grant opportunities that could help offset the cost of vehicles and infrastructure.

Table 4: BEB vs Diesel Bus Cost Comparison

Cost Category	BEB Cost Compared to Diesel	Notes
Vehicle	Higher	Vehicles at least 40% more expensive, primarily due to battery cost ⁶
Fueling Infrastructure	Higher	New infrastructure needed, significant capital and installation costs
Maintenance (Vehicle)	Lower	May initially be higher due to training needs, long term lower due to fewer parts
Maintenance (Fueling Infrastructure)	Equal/Higher	Slow charger maintenance estimated equal to diesel fueling station maintenance. Fast charger maintenance estimated more expensive
Fuel Costs	Lower	Based on Corvallis electricity and diesel costs
Lifecycle GHG Emissions	Lower	74% lower lifecycle GHG emissions vs diesel ⁷
Tailpipe Emissions	Zero	BEBs have zero tailpipe emissions

⁶ Transit Cooperative Research Program. *Battery Electric Buses – State of the Practice*. Transportation Research Board, 2018.

⁷ O’Dea, Jimmy. “Electric vs. Diesel vs. Natural Gas: Which Bus is Best for the Climate?” Union of Concerned Scientists, 2018 <https://blog.ucsusa.org/jimmy-odea/electric-vs-diesel-vs-natural-gas-which-bus-is-best-for-the-climate> (accessed September 11, 2018).

Average Capital Costs⁸

- Bus - \$887,308
- Slow charge infrastructure – \$67,050 (can serve up to two buses)
- Fast charge infrastructure - \$698,447 (can serve up to six buses)

Electricity Costs

- \$0.112/kWh⁹

Maintenance Costs

- Bus maintenance – \$19,200/year¹⁰
- Slow charger maintenance - \$200/year¹¹
- Fast charger maintenance - \$0.026/kWh¹²

Social Costs

Electric buses produce no tailpipe emissions and are quieter than conventional diesel buses. Based on Oregon’s electricity mix, lifecycle GHG emissions are reduced through BEB use. These social benefits can’t be captured in real dollars by transit providers (unless cap-and-trade policies are adopted at the state or federal level) but they can justify the increased bus and infrastructure costs for transitioning to a zero-emission transit fleet.

With a 74% reduction in lifecycle GHG emissions and zero tailpipe emissions, BEBs represent an annual savings of over \$8,500 per bus in social costs for the Corvallis community.¹³

Table 5: Annual Social Cost of Bus Emissions

Bus Type	Cost of CO₂ Emissions	Cost of Air Pollutant Emissions	Total Cost of Emissions
Diesel	\$3,775	\$4,730	\$8,505
BEB	\$982	\$0	\$982

Based on emissions for a single bus driving 30,000 annual miles

Source: ODOT Alternative Fuels Bus Cost Calculator

⁸ Transit Cooperative Research Program. *Battery Electric Buses – State of the Practice*. Transportation Research Board, 2018.

⁹ Average 2018 utility cost for City of Corvallis, per Scott Dybvad.

¹⁰ Average maintenance cost per mile of \$0.64 from *Battery Electric Buses – State of the Practice*. Transportation Research Board, 2018.

¹¹ King County Feasibility Study Metro Transit Division. *Feasibility of Achieving a Carbon-Neutral or Zero-Emission Fleet*. King County Metro Department of Transportation, 2017.

¹² California Air Resources Board. *Transit Fleet Cost Model Spreadsheet*. 2018

<https://www.arb.ca.gov/regact/2018/ict2018/appk-transitfleetcostmodel.xlsx? ga=2.117480393.1599391041.1549383500-1021018514.1549383500> (accessed February 5, 2019).

¹³ ODOT Alternative Fuels Bus Cost Calculator.

Figure 3: Annual Bus Operating Costs by Technology Type

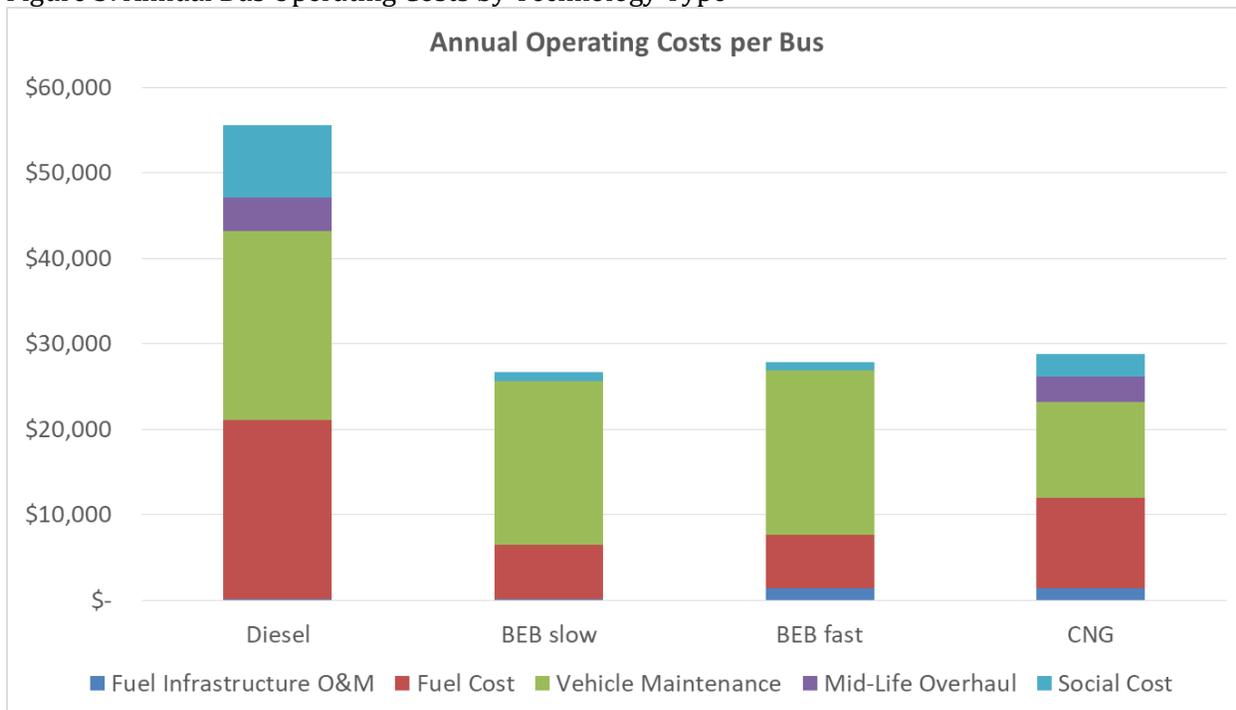
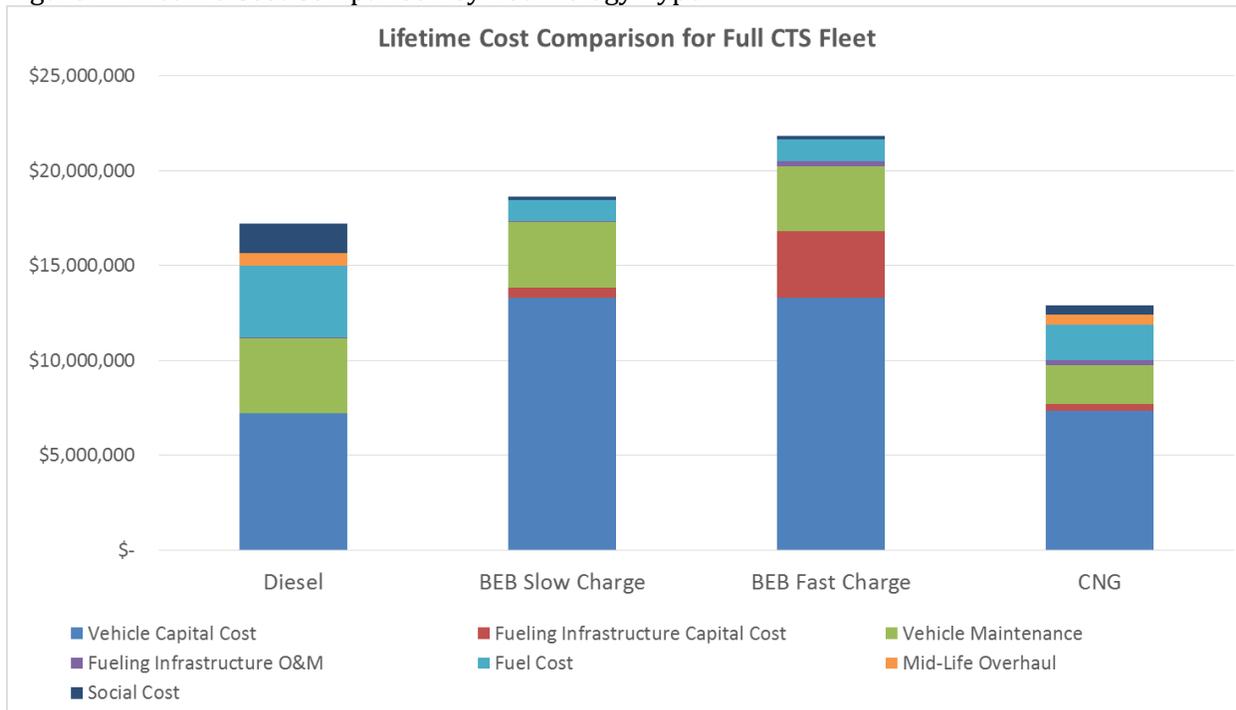


Figure 4: Lifetime Cost Comparison by Technology Type



Potential Funding Sources

There are a number of federal grant programs Corvallis could apply for the purchase of battery electric buses. These include:

- FTA Lo-No program grants
- FTA TIGGER grants
- FTA Clean Fuels program grants

In addition, some opportunities exist at the state level, including:

- HB 2017 STIF funds
- Tax credits
- Clean fuel credits

Feasibility Considerations & Next Steps

Feasibility Determination

Based on the literature review, transit provider interviews, and cost considerations, OCWCOG staff have determined that battery electric buses can feasibly be implemented in Corvallis. Many transit agencies in the US are successfully operating BEBs, and Corvallis does not have any unique challenges that suggest BEBs would not be able to meet the needs of CTS. However, there are many variables determining the cost, efficiency, and long term impacts of BEB operations within the context of the Corvallis Transit System that need to be chosen using a policy and/or economic lens.

In our interviews with providers around the state, agencies moved forward with electric buses for one of three reasons:

- 1) The environmental benefits, supported and advocated for by the community at large (Policy Decision)
- 2) The reduced fuel and maintenance costs seen internally (Financial Decision)
- 3) Both environmental and cost benefits

As City of Corvallis staff and elected officials consider implementing electric buses, there are interim steps that include:

- Visit agencies in Oregon currently implementing electric buses
- Contact electric bus manufacturers to discuss pricing and brand specific benefits
- Have electric bus manufacturers visit Corvallis with a test vehicle

CAMPO staff would be happy to assist in any of these endeavors.

Conclusion

The Corvallis Area MPO recommends a conversation with city staff on the policy considerations outlined above. This information can then be brought forward to City Council and the general public for discussion. If Corvallis chooses to move forward with implementation, a list of considerations for planning the transition to electric buses are included in Attachment A.

Attachment A: Electric Bus Implementation Considerations

Planning and Procurement:

- Who will be responsible for evaluating the necessary battery range and appropriate charging infrastructure?
- Who will assure a quality product is delivered by the manufacturer?
- Oregon transit agencies that were interviewed recommend dedicating a full time staff person or the use of a consultant.
- Agencies surveyed in TCRP study responded that over half relied on staff and almost one third used a consultant. Some agencies also used modeling and simulation techniques, though a key finding from the study was that the availability of useful BEB modeling software is lacking.

Fast vs Slow Charging:

- Slow charging infrastructure is cheaper, and only requires new infrastructure in one location (typically the bus depot/maintenance facility.) However, long charge times may require a surplus of chargers or increased labor hours.
- Slow charge buses generally have larger batteries and thus have higher capital costs. If the range isn't enough to run all day they can't be quickly refueled and may need to be swapped with a second bus if downtime isn't scheduled into their route.
- Fast charge buses can operate with smaller batteries, which can result in lower capital costs. However, buses with small batteries have short ranges and require frequent recharging.
- Fast charge infrastructure is more expensive, and depending on the route length and battery size, multiple chargers may be needed to maintain bus charge.
- Electricity access can be more difficult for fast chargers if they are placed along the bus route. Corvallis may be able to use the Downtown Transit Center as a fast charge hub for all buses, but additional chargers may be needed on longer routes.
- Fast charge infrastructure is route dependent, moving the chargers due to route changes would be prohibitively costly meaning routes would be less flexible.
- Some agencies use a combination of slow and fast charge infrastructure, but it is more common for agencies to select one approach. Reasons agencies use both charging types include electrifying long routes, maintaining a high minimum battery charge to extend battery lifespan, or to test both types of charging infrastructure.

Buy vs Lease:

- Rapid technology change makes leasing attractive as agencies could more quickly take advantage of battery and charging improvements while still gaining experience with BEB operations.
- Lease contracts can provide a safety net in case the vehicle or battery lifespan is less than the manufacturer expects. The oldest BEB currently in operation in the US is seven years old, and the full lifespan of BEBs and their batteries is yet unknown.
- Most transit agencies choose to purchase BEBs. This may be due to leasing costs or funding options that prevent leasing.
- Current cost calculations show that BEBs are more expensive than diesel or CNG buses over a 12 year lifespan.
- Buying allows for reuse opportunities of decayed batteries. Batteries are unusable for bus propulsion once they degrade below 70% capacity, but they are still useful for energy storage. Old batteries could be used as emergency backups or for solar power storage.