BOARD OF DIRECTORS
REGULAR MEETING
Thursday, February 9, 2023, at 6 p.m.
Benton County Administration Building, Room 303
7122 W. Okanogan Place Building E, Kennewick, Washington

Notice: Meeting attendance options include in person and virtual via Zoom
Spanish language translation is available via Zoom

Meeting Link:
https://zoom.us/j/98962178731?pwd=OGg1amhEQXA0RG5QRTdqNnFpRGN5dz09
Phone: 253-215-8782 / Toll Free: 877-853-5247
Meeting ID: 989 6217 8731 / Password: 833979

If you wish to provide written comments to the Board or speak during the Public Comments portion of a Board meeting, please submit this form. Public comments will be taken during the meeting as indicated in the agenda below.

AGENDA

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1. **Convene Board Meeting** — Chair Will McKay
2. **Roll Call** — Janet Brett
3. **Pledge of Allegiance** — Chair McKay
4. **Public Comments** — Chair McKay
5. **Approval of Agenda** *(page 1)* — Chair McKay
6. **Election of Officers** — Jeremy Bishop
   - **A. Chair/Vice Chair**
   - **B. Committee Selections**
   - **C. BFCOG Representative**
7. **Consent Agenda**
   - **A.** January 12, 2023, Regular Board Meeting Minutes *(page 5)*
   - **B.** January Voucher Summary *(page 9)*

C. Resolution 6-2023 Authorizing the General Manager to Declare Old and Failed Information Technology Items as Surplus and Dispose of per Resolution 62-2014 *(page 29)*

8. Discussion & Informational Items

A. Informational Report on Fleet Transition *(page 37)* Joshua Rosas

B. Fourth Quarter 2022 Performance Report *(page 137)* Kevin Sliger

9. Staff Reports & Comments

A. Legal Report Jeremy Bishop

B. General Manager's Report Rachelle Glazier

10. Board Member Comments

11. Executive Session

12. Other

13. Next Meeting

Regular Board Meeting – Thursday, March 9, 2023, at 6 p.m.

14. Adjournment

JUNTA DIRECTIVA

REUNIÓN ORDINARIA

Jueves, 9 de febrero de 2023, a las 6 p.m.
Edificio de la Administración del Condado de Benton, Sala 303
7122 W. Okanogan Place Building E, Kennewick, Washington

Aviso: Las opciones de asistencia a las reuniones incluyen las presenciales y las virtuales a través de Zoom
La traducción al español está disponible a través de Zoom

Enlace de la reunión:
https://zoom.us/j/98962178731?pwd=OGg1amhEQXA0RG5QRTdqNnFpRGN5dz09
Teléfono: 253-215-8782 / Número gratuito: 877-853-5247
ID de reunión: 989 6217 8731 / Contraseña: 833979

Si desea hacer comentarios por escrito a la Junta o intervenir durante la parte de comentarios públicos de una reunión de la Junta, envíe este formulario. Los comentarios públicos durante la reunión se harán según lo indicado en la agenda a continuación.

AGENDA

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1. **Convocar reunión de la Junta** — Presidente Will McKay
2. **Pase de lista** — Janet Brett
3. **Juramento de Lealtad** — Presidente McKay
4. **Comentarios públicos** — Presidente McKay
5. **Aprobación de la agenda** *(página 1)* — Presidente McKay
6. **Elección de los miembros de la junta** — Jeremy Bishop
   - **A. Presidente/Vicepresidente**
   - **B. Selecciones de comités**
   - **C. Representante de BFCOG**
7. **Agenda de consentimiento**
   - **A.** 12 de enero de 2023, Actas de la reunión ordinaria de la Junta (*página 5*)
   - **B.** Resumen de los comprobantes de enero (*página 9*)

C. Resolución 6-2023 por la que se autoriza al Director General a declarar excedentes los artículos de tecnología de la información antiguos y averiados y a disponer de ellos conforme a la Resolución 62-2014 (*página 29*)

8. Temas de debate y de información

A. Documento informativo sobre la transición de la flota (*página 37*) — Joshua Rosas

B. Informe de rendimiento del cuarto trimestre de 2022 (*página 137*) — Kevin Sliger

9. Informes y comentarios del personal

A. Informe Jurídico — Jeremy Bishop

B. Informe del Director General — Rachelle Glazier

10. Comentarios de los miembros de la Junta

11. Sesión ejecutiva

12. Otros

13. Próxima reunión

Reunión ordinaria de la Junta - Jueves, 9 de marzo de 2023, a las 6 p.m.

14. Aplazamiento

BOARD OF DIRECTORS
REGULAR MEETING
Thursday, January 12, 2023, at 6 p.m.
Benton County Administration Building, Room 303
7122 W. Okanogan Place Building E, Kennewick, Washington

Meeting attendance options included in person and virtual via Zoom

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MINUTES

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1. **CONVENE BOARD MEETING**
   Chair Will McKay called the meeting to order at 6:03 p.m.

2. **ROLL CALL**

Representing	Attendee Name	Title	Status
City of Pasco	Joseph Campos	Director	Present
City of Kennewick	Brad Beauchamp	Director	Present
City of Richland	Terry Christensen	Director	Present
City of West Richland	Richard Bloom	Vice Chair	Present
Franklin County #2	Rocky Mullen	Director	Present
Franklin County #1	Clint Didier	Director	Present
Benton County	Will McKay	Chair	Present
City of Prosser	Steve Becken	Director	Present
City of Benton City	David Sandretto	Director	Present
Teamsters Union 839	Caleb Suttle	Union Representative	Present

BFT Staff: Rachelle Glazier, Janet Brett, Jaslyn Campbell, Chad Crouch, Steve Davis, Angelica Gutierrez, Tom McCormick, Rob Orvis, Rahul Ranade, Ashley Rolland, Kevin Sliger, Rich Starr
Legal Counsel: Jeremy Bishop
Interpreters: Ruth Medina, Ynez Vargas

3. **PLEDGE OF ALLEGIANCE**
   Chair McKay led the meeting participants in the Pledge of Allegiance.

4. **PUBLIC COMMENTS**
   Chair McKay opened the meeting to comments from the public. No public comments were offered.

5. **APPROVAL OF AGENDA**

Chair McKay asked for a motion to approve the agenda.

Vice Chair Bloom moved to approve the agenda, and Director Sandretto seconded the motion. It passed unanimously.

6. <u>**RECOGNITIONS**</u>

A. Resolution 1-2023 Recognizing BFT Employee Mona Jamison's Years of Service

Acting Senior Manager of Customer Experience Steve Davis recognized Mona Jamison for her 28 years of service to BFT. He presented her with a framed certificate and lifetime bus pass.

Vice Chair Bloom moved to approve Resolution 1-2023, and Director Sandretto seconded the motion. It passed unanimously.

B. Resolution 2-2023 Recognizing BFT Employee Christina Martin's Years of Service

Senior Manager of Operations Tom McCormick read the resolution recognizing Christina Martin for her 27 years of service.

Vice Chair Bloom moved to approve Resolution 2-2023, and Director Sandretto seconded the motion. It passed unanimously.

C. Resolution 3-2023 Recognizing BFT Employee Tacine Schuyler's Years of Service

Mr. McCormick read the resolution in recognition of Tacine Schuyler's 19 years of service to BFT.

Vice Chair Bloom moved to approve Resolution 3-2023, and Director Sandretto seconded the motion. It passed unanimously.

7. <u>**CONSENT AGENDA**</u>

Chair McKay presented the Consent Agenda items and invited a motion.

A. December 8, 2022, Regular Board Meeting Minutes

B. December Voucher Summary

C. Resolution 4-2023 Authorizing the General Manager to Declare Vehicles Listed in Exhibit A as Surplus and Dispose of per Resolution 59-2018

Director Sandretto moved for approval of the Consent Agenda items. The motion was seconded by Vice Chair Bloom and passed unanimously.

8. <u>**ACTION ITEM**</u>

A. Resolution 5-2023: Approve an Increase to the Purchase Cost in Resolution 68-2022 for Project FLT0027 to Purchase Twenty-Five (25) Vanpool Minivans Utilizing Washington State Contract #05916

Manager of Rideshare & Vanpool Terry DeJuan presented a memorandum and resolution for Board approval of an increase in the cost to purchase 25 Vanpool minivans. The cost increase is almost $4,000 per vehicle, for a total price increase of approximately $100,000 over what was approved by the Board in November for this purchase.

Vice Chair Bloom moved to approve Resolution 5-2023, and Director Christensen seconded the motion. It passed unanimously.

9. <u>DISCUSSION & INFORMATIONAL ITEM</u>

A. Proposed Fare Structure for Board Review and Input Prior to Title VI Analysis and Release for Public Comment

Chief Planning & Development Officer Kevin Sliger presented a memo for Board information on the proposed fare structure. He asked for Board input on the proposal prior to completing a Title VI analysis on it and releasing it for public comment. After discussion and questions by Board members, they agreed with the proposal. It will be brought back before the Board for approval in March or April.

10. <u>STAFF REPORTS & COMMENTS</u>

A. Legal Report

BFT Legal Counsel Jeremy Bishop announced he had no news.

B. General Manager's Report

General Manager Rachelle Glazier reported on Saturday's successful hiring event held at Three Rivers. Over 100 applicants came to the event, interviews were conducted by a large team of BFT staff, and 30 job offers were sent out this week.

A second round of the Hanford survey will be sent out to get responses from more participants now that the holidays are over. We should have the survey data compiled by the end of January in the hopes of getting a pilot in place in the first quarter of 2023.

We have not received any updates from Amazon on the opening date of their Pasco facility. We still plan to kick off the Route 64 service, but it does not appear we will be servicing Amazon when it begins.

11. <u>BOARD MEMBER COMMENTS</u>

Director Steve Becken told his fellow Board members that Rachelle met with the Prosser City Council and mayor on Tuesday night. She did a great job on her presentation—no one had any questions.

Vice Chair Bloom plans to attend the APTA Marketing & Communications Workshop in Las Vegas in February. He has a townhouse there, so Board members who wish to attend may stay there and carpool to the event.

Vice Chair Bloom also encouraged Board members to attend the APTA Legislative Conference in Washington, D.C. in March.

Director Caleb Suttle is on the Pasco Little League Board, and teams are looking for sponsorships. If you know of any businesses or individuals willing to help, please let him know.

12. <u>EXECUTIVE SESSION</u>

Mr. Bishop announced an Executive Session would be held under RCW 42.30.110(1)(g) regarding evaluation of public employee performance. The session will last 5 minutes, with no anticipated action afterwards. The Board recessed at 6:33 p.m. and returned to open session at 6:42 p.m.

13. OTHER

There were no other agenda items.

14. NEXT MEETING

The next meeting will be held Thursday, February 9, 2023, at 6 p.m.

15. ADJOURNMENT

Chair McKay adjourned the meeting at 6:42 p.m.

Janet M. Brett, Clerk of the Board	Date

1000 Columbia Park Trail, Richland, WA 99352
509.735.4131 | 509.735.1800 fax | www.bft.org

Transit
BEN FRANKLIN TRANSIT

Friday, February 3, 2023
To: Ben Franklin Board of Directors
From: Rachelle Glazier, General Manager
RE: Vouchers for January 2023

Signature: Rachelle Glazier (Feb 3, 2023 15:51 PST)
Email: rglazier@bft.org

January 2023 vouchers totaled $10,000,953.88. An analysis of the vouchers had the following significant vendor payment amounts:

Vendor	Description	Amount	
GILLIG	Vehicles & Parts	$	4,721,094.59
WA STATE TRANSIT INS. POOL	Insurance	$	848,532.00
IRS	Federal Income Tax on Wages	$	423,840.10
NW ADMIN TRANSFER	Insurance	$	408,984.50
DEPT OF RETIREMENT SYSTEMS	PERS	$	327,437.10
ASSOCIATED PETROLEUM PRODUCTS INC	Fuel	$	272,485.46
P&M HOLDING GROUP LLP	Contracted Services	$	255,236.65
DEPT LABOR & INDUSTRIES	Payroll Taxes	$	234,260.06
RIVER NORTH TRANSIT LLC	Contracted Services	$	208,762.04
STATE OF WASHINGTON	Insurance	$	112,931.95
SIEFKEN & SONS CONSTRUCTION INC	Contracted Services	$	104,080.21
WESTERN CONFERENCE OF	Teamsters Pension	$	78,353.68
CITY OF RICHLAND	Utilities	$	63,724.39
EDNETICS INC	Computer Supplies	$	43,884.26
ARC OF THE TRI-CITIES INC	Contracted Services	$	42,365.16
CDW GOVERNMENT INC.	Computer Supplies	$	40,797.72
EMPLOYMENT SECURITY DEPARTMENT	Payroll Taxes	$	38,071.44
WEX BANK	Fuel	$	33,868.67
US BANKCARD	Travel/Merchandise	$	29,127.87
CUMMINS INC	Vehicle Parts	$	28,853.50
BENTON-FRANKLIN COUNCIL	Membership	$	26,108.00
BUSINESS RADIO INC	Radio Maintenace	$	23,203.85
ARCHBRIGHT INC	Contracted Services	$	20,376.00
THE GREG PROTHMAN COMPANY	Contracted Services	$	18,308.34
NORTHWEST BUS SALES INC	Vehicle Parts	$	16,831.45
TEAMSTERS UNION	Payroll Deductions	$	16,734.50
FGL LLC	Property Lease	$	14,492.33
CASCADE NATURAL GAS CORPORATION	Utilities	$	14,091.23
BRIDGESTONE AMERICAS INC	Tire Lease	$	13,859.05
AARON C GRIMM	Contracted Services	$	12,335.00
NORTHWEST MOVERS CENTRAL LLC	Contracted Services	$	11,441.25
VERIZON WIRELESS	Wireless Services	$	10,075.93
	Total Significant Vendors	**$**	**8,514,548.28**
	Payroll Total	**$**	**1,222,449.62**

I, the undersigned **CHAIRMAN/VICE-CHAIRMAN of BEN FRANKLIN TRANSIT**
Benton County, Washington, do hereby certify that the payroll related services, herein specified have been received and that the following checks are approved for payment for the month of January 2023.

PAYROLL

Check Register Number	Check Number / Number		Date of Issue	In the Amount	
501-23	80932	80933	1/7/2023	610,923.61	Payroll
502-23	80934	80935	1/21/2023	611,526.01	Payroll
			Total	**$ 1,222,449.62**	

AUTHORITY MEMBER
2/9/2023

I, the undersigned **CHAIRMAN/VICE-CHAIRMAN of BEN FRANKLIN TRANSIT**
Benton County, Washington, do hereby certify that the merchandise or services herein specified have been received and that the following checks are approved for payment for the month of January 2023.

ACCOUNTS PAYABLE

Check Register Number	Check Number / Number		Date of Issue	In the Amount	
100-23	83267	83301	1/4/2023	4,910,339.31	MDSE
101-23	ACH TRANS		1/11/2023	438,112.37	ACH TRANS
102-23	83302	83356	1/13/2023	382,675.14	MDSE
103-23	83357	83374	1/16/2023	61,826.51	MDSE
104-23	83375	83397	1/17/2023	910,815.92	MDSE
105-23	83398	83451	1/24/2023	848,884.63	MDSE
106-23	83452	83504	1/27/2023	353,436.42	MDSE
107-23	83505	83521	1/31/2023	105,987.62	MDSE
108-23	ACH TRANS		1/13/2023	540,904.27	ACH TRANS
109-23	ACH TRANS		1/20/2023	254.11	ACH TRANS
110-23	ACH TRANS		1/25/2023	744.79	ACH TRANS
111-23	ACH TRANS		1/27/2023	223,216.06	ACH TRANS
112-23	ACH TRANS		1/5/2023	4,500.00	ACH TRANS
113-23	82522, 83228		1/25/2023	(3,192.89)	VOID
			Total	**$ 8,778,504.26**	

AUTHORITY MEMBER
2/9/2023

January 2023 vouchers audited and certified by Ben Franklin Transit's auditing officer as required by RCW 42.24.080, and those expense reimbursement claims certified as required by RCW 42.24.090, have been recorded on a listing which has been emailed to the Board members February 9, 2023.

ACTION: As of this date, February 9, I, __________________________
move that the following checks be approved for payment:

PAYROLL

Check Register Number	Check Number / Number		Date of Issue	In the Amount	
501-23	80932	80933	1/7/2023	610,923.61	Payroll
502-23	80934	80935	1/21/2023	611,526.01	Payroll
			Total	**$ 1,222,449.62**	

ACCOUNTS PAYABLE

Check Register Number	Check Number / Number		Date of Issue	In the Amount	
100-23	83267	83301	1/4/2023	4,910,339.31	MDSE
101-23	ACH TRANS		1/11/2023	438,112.37	ACH TRANS
102-23	83302	83356	1/13/2023	382,675.14	MDSE
103-23	83357	83374	1/16/2023	61,826.51	MDSE
104-23	83375	83397	1/17/2023	910,815.92	MDSE
105-23	83398	83451	1/24/2023	848,884.63	MDSE
106-23	83452	83504	1/27/2023	353,436.42	MDSE
107-23	83505	83521	1/31/2023	105,987.62	MDSE
108-23	ACH TRANS		1/13/2023	540,904.27	ACH TRANS
109-23	ACH TRANS		1/20/2023	254.11	ACH TRANS
110-23	ACH TRANS		1/25/2023	744.79	ACH TRANS
111-23	ACH TRANS		1/27/2023	223,216.06	ACH TRANS
112-23	ACH TRANS		1/5/2023	4,500.00	ACH TRANS
113-23	82522, 83228		1/25/2023	(3,192.89)	VOID
			Total	**$ 8,778,504.26**	

Check Register Nos. 501-23 to 502-23 and 100-23 to 113-23 in the total amount of: **$ 10,000,953.88**

The motion was seconded by ____ and approved by a unanimous vote.

CHECK REGISTER CERTIFICATION

PAYROLL

CHECK REGISTER NUMBER 501-23

CHECK NUMBERS	80932-80933	$	1,411.52
ACH TRANSFER		$	609,512.09

PAYROLL DATE JANUARY 13, 2023

PURPOSE: PPE 01/07/2023 AMOUNT: **$610,923.61**

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered, or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR

1/12/2023

DATE

CHECK REGISTER CERTIFICATION

PAYROLL

CHECK REGISTER NUMBER 502-23

CHECK NUMBERS	80934-80935	$	2,112.64
ACH TRANSFER		$	609,413.37

PAYROLL DATE JANUARY 27, 2023

PURPOSE: PPE 01/21/2023 AMOUNT: **$611,526.01**

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered, or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

[signature] 1/25/2023

AUDITOR DATE

BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 100-23

CHECK NUMBERS 83267 to 83301

DATE 1/4/2023

PURPOSE AP JAN23A VOUCHERS AMOUNT $4,910,339.31

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR DATE 1/18/2023

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 101-23

ACH WIRE TRANSFERS

DATE: 1/11/23

PURPOSE:

US BANK CORPORATE PAYMENT SYSTEMS	$29,127.87
N.W. ADMIN TRANSFER ACCOUNT	$408,984.50
	$438,112.37

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR DATE 1/18/2023

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 102-23

CHECK NUMBERS 83302 to 83356

DATE 1/13/2023

PURPOSE AP JAN23B VOUCHERS AMOUNT $382,675.14

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR DATE 1/18/2023

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 103-23

CHECK NUMBERS 83357 to 83374

DATE 1/16/2023

PURPOSE AP JAN23C VOUCHERS AMOUNT $61,826.51

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR DATE 1/18/2023

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 104-23

CHECK NUMBERS 83375 to 83397

DATE 1/17/2023

PURPOSE AP JAN23D VOUCHERS AMOUNT $910,815.92

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

AUDITOR DATE 1/18/2023

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 105-23

CHECK NUMBERS 83398 to 83451

DATE 1/24/2023

PURPOSE AP JAN23E VOUCHERS AMOUNT $848,884.63

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 15:14 PST)

AUDITOR

Feb 3, 2023

DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 106-23

CHECK NUMBERS 83452 to 83504

DATE 1/27/2023

PURPOSE AP JAN23F VOUCHERS AMOUNT $353,436.42

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 13:31 PST)

AUDITOR

Feb 3, 2023

DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 107-23

CHECK NUMBERS 83505 to 83521

DATE 1/31/2023

PURPOSE AP JAN23G VOUCHERS AMOUNT $105,987.62

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 15:13 PST) Feb 3, 2023

AUDITOR DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 108-23

ACH WIRE TRANSFERS

DATE: 1/13/23

PURPOSE:

WASHINGTON STATE SUPPORT	$2,476.37
INTERNAL REVENUE SERVICE TAXES	$207,237.28
DEPT OF RETIREMENT SYSTEMS - DRS	$327,182.99
DEPT OF RETIREMENT SYSTEMS - DCP	$2,834.74
AW REHN & ASSOCIATES	$1,172.89
	$540,904.27

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 13:32 PST)
AUDITOR

Feb 3, 2023
DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 109-23

ACH WIRE TRANSFERS

DATE: 1/20/23

PURPOSE:

DEPT OF RETIREMENT SYSTEMS - DRS	$254.11
	$254.11

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 13:32 PST)
AUDITOR

Feb 3, 2023
DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 110-23

ACH WIRE TRANSFERS

DATE: 1/25/23

PURPOSE:

STATE OF WASHINGTON ACH	$744.79
	$744.79

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 13:32 PST)
AUDITOR

Feb 3, 2023
DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 111-23

ACH WIRE TRANSFERS

DATE: 1/27/23

PURPOSE:

WASHINGTON STATE SUPPORT	$2,476.37
INTERNAL REVENUE SERVICE TAXES	$216,602.82
DEPT OF RETIREMENT SYSTEMS - DCP	$2,838.98
AW REHN & ASSOCIATES	$1,297.89
	$223,216.06

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Rachelle Glazier (Feb 3, 2023 13:32 PST)
AUDITOR

Feb 3, 2023
DATE

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BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER: 112-23

ACH WIRE TRANSFERS

DATE: 1/5/23

PURPOSE:

HRA VEBA TRUST	$4,500.00
	$4,500.00

"I, the undersigned, do hereby certify under penalty of perjury that the materials have been furnished, the services rendered or the labor performed as described herein and that the claims are just, due and unpaid obligations against Ben Franklin Transit, and that I am authorized to authenticate and certify said claims."

Ra chelle Glazier (Feb 3, 2023 14:08 PST)
AUDITOR

Feb 3, 2023
DATE

T:\USER\Accounting\Accounts Payable\AP\WARREGACH

BEN FRANKLIN TRANSIT

CHECK REGISTER CERTIFICATION

ACCOUNTS PAYABLE

CHECK REGISTER NUMBER 113-23

CHECK NUMBERS 82522, 83228

DATE 1/25/2023

PURPOSE A/P VOID CHECK AMOUNT ($3,192.89)

"I, the undersigned, do hereby certify, under penalty of perjury under the laws of the State of Washington, that the orginal instrument(s) was (were) either,1) based upon the attached Affidavit(s) from the vendor(s), lost or destroyed and has (have) not been paid, or 2) is (are) in Ben Franklin Transit's possession and has (have) been determined to be null-and-void and that I am authorized to authenticate and certify the above and hereby the instrument(s) is (are) canceled."

Rachelle Glazier (Feb 3, 2023 13:20 PST)
AUDITOR

Feb 3, 2023
DATE

T:\USER\Accounting\Accounts Payable\AP\WARREGVOID

Memorandum

Date: February 9, 2023

To: Rachelle Glazier, General Manager

From: Michael Roberts, Information Technology Manager

Re: Resolution 6-2023 Authorizing the General Manager to Declare Old and Failed Information Technology Items as Surplus and Dispose of per Resolution 62-2014

Background

Resolution 62-2014 states that Ben Franklin Transit (BFT) shall dispose of surplus property through a process at the discretion of the General Manager. The process will start with the value of the property, which will be established by determining current market value and researching past sales. Vehicles may be sold to nonprofit organizations; municipal corporations; other units of state or local government; or to the general public, which would include public notification regarding the sale of surplus property.

Surplus property may be sold through a live or online auction with no minimum bid. Vehicles or equipment that has been totaled, has had mechanical failure, or is of no reasonable value for resale may be sold for scrap or salvage after BFT staff have determined the property to be unsafe or beyond repair.

As a data security precaution, all hard drives will be removed from computer systems and will be disposed of through a separate destructive process. This effectively renders all computers inoperable and valueless. As such, they will not be able to be disposed of through auction or other sales processes; our recourse is disposition through recycling venues.

Funding

Budgeted: N/A
Budget Source: N/A
Funding Source: N/A

Recommendation

Approve Resolution 6-2023 authorizing the General Manager to declare old and failed information technology items as surplus and dispose of per Resolution 62-2014.

Forwarded as presented:

____

Rachelle Glazier, General Manager

BEN FRANKLIN TRANSIT
RESOLUTION 6-2023

A RESOLUTION AUTHORIZING THE GENERAL MANAGER TO DECLARE THE ITEMS IDENTIFIED ON EXHIBIT A: "LIST OF SURPLUS INFORMATION TECHNOLOGY ITEMS" AS SURPLUS AND DISPOSE OF PER RESOLUTION 62-2014

WHEREAS, Ben Franklin Transit (BFT) owns Information Technology computing items;

WHEREAS, Information Technology computing items will wear out and fail in the normal course of their useful life; and

WHEREAS, The items on the attached Exhibit A are beyond useful life or have failed and have no market or residual value;

NOW, THEREFORE, BE IT RESOLVED BY THE BEN FRANKLIN TRANSIT BOARD OF DIRECTORS THAT:

1. The General Manager is authorized to declare the identified Information Technology items surplus (which is attached to this resolution as Exhibit A: List of Surplus Information Technology Items and incorporated herein by reference).
2. The General Manager is authorized to dispose of items listed on Exhibit A: List of Surplus Information Technology Items per Resolution 62-2014.

APPROVED AT A REGULAR BEN FRANKLIN TRANSIT BOARD OF DIRECTORS meeting held Thursday, February 9, 2023, at 7122 W. Okanogan Place Building E, Kennewick, Washington.

ATTEST:

____
Janet M. Brett, Clerk of the Board

____
Will McKay, Chair

APPROVED AS TO FORM BY:

____
Jeremy J. Bishop, Legal Counsel

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	HG7CXG2	051491	11-014	Deskstop PC	Dell	OptiPlex 5040	1/17/2017
MD	1KV8ZG2	051497	66-007	Deskstop PC	Dell	OptiPlex 5040	1/23/2017
MD	HGNDXG2	051499	66-003	Deskstop PC	Dell	OptiPlex 5040	1/17/2017
MD	1K64ZG2	052142	21-009	Deskstop PC	Dell	OptiPlex 5040	1/23/2017
MD	294HDV2	052092	73-002	Deskstop PC	Dell	OptiPlex 5060	3/8/2019
MD	29CJDV2	052098	11-017	Deskstop PC	Dell	OptiPlex 5060	3/8/2019
MD	29WHDV2	052113	21-023	Deskstop PC	Dell	OptiPlex 5060	3/13/2019
MD	29QHDV2	052537	74-033	Deskstop PC	Dell	OptiPlex 5060	2/18/2019
MD	6228M82	051420	60-002	Deskstop PC	Dell	OptiPlex 7020	3/10/2016
MD	6236M82	051510	73-001	Deskstop PC	Dell	OptiPlex 7020	3/10/2016
MD	6GYVKS1	050924		Desktop - Mid Tower	Dell	OptiPlex 780	
MD	7GR5XL1	050792		Desktop - Mid Tower	Dell	OptiPlex 790	
MD	11N517503756			IP Phone	Avaya	9650	
MD	11N531401451			IP Phone	Avaya	9650	
MD	12N530201266			IP Phone	Avaya	9650	
MD	08N536606307			IP Phone	Avaya	9650	
MD	11N530504135			IP Phone	Avaya	9650	
MD	11N530606418			IP Phone	Avaya	9650	
MD	11N526504707			IP Phone	Avaya	9650	
MD	10N505306347			IP Phone	Avaya	9650	
MD	13N505401454			IP Phone	Avaya	9650	
MD	10FA23004107			IP Phone	Avaya	9650	
MD	11N532009908			IP Phone	Avaya	9650	
MD	11N530504070			IP Phone	Avaya	9650	
MD	08N533606184			IP Phone	Avaya	9650	
MD	10FA23004056			IP Phone	Avaya	9650	
MD	13N505309828			IP Phone	Avaya	9650	
MD	11N530206545			IP Phone	Avaya	9650	

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	10FA31006265			IP Phone	Avaya	9650	
MD	07N509922418			IP Phone	Avaya	9650	
MD	10FA23004087			IP Phone	Avaya	9650	
MD	08N509204970			IP Phone	Avaya	9650	
MD	10FA23004066			IP Phone	Avaya	9650	
MD	10FA23004086			IP Phone	Avaya	9650	
MD	10N503306635			IP Phone	Avaya	9650	
MD	09N526003082			IP Phone	Avaya	9650	
MD	12N506401388			IP Phone	Avaya	9650	
MD	10FA23004106			IP Phone	Avaya	9650	
MD	2258437			IP Phone	Avaya	9650	
MD	11N545203482			IP Phone	Avaya	9650	
MD	09N526002425			IP Phone	Avaya	9650	
MD	08N521203209			IP Phone	Avaya	9650	
MD	10FA23004099			IP Phone	Avaya	9650	
MD	2258425			IP Phone	Avaya	9650	
MD	10FA23004125			IP Phone	Avaya	9650	
MD	13N505401205			IP Phone	Avaya	9650	
MD	11N517503776			IP Phone	Avaya	9650	
MD	08N527300553			IP Phone	Avaya	9650	
MD	2258439			IP Phone	Avaya	9650	
MD	13N505403087			IP Phone	Avaya	9650	
MD	13N505309850			IP Phone	Avaya	9650	
MD	10N547601254			IP Phone	Avaya	9650	
MD	13N516312836			IP Phone	Avaya	9650	
MD	08N531203631			IP Phone	Avaya	9650	
MD	10N545504863			IP Phone	Avaya	9650	
MD	12N506403098			IP Phone	Avaya	9650	

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	10FA23004063			IP Phone	Avaya	9650	
MD	13N503005086			IP Phone	Avaya	9650	
MD	13N505403083			IP Phone	Avaya	9650	
MD	10N505506755			IP Phone	Avaya	9650	
MD	08N531203517			IP Phone	Avaya	9650	
MD	11N534004537			IP Phone	Avaya	9650	
MD	09N520306008			IP Phone	Avaya	9650	
MD	10FA23004094			IP Phone	Avaya	9650	
MD	13N505401611			IP Phone	Avaya	9650	
MD	13N505403188			IP Phone	Avaya	9650	
MD	08N521301050			IP Phone	Avaya	9650	
MD	10N526201668			IP Phone	Avaya	9650	
MD	12N502302144			IP Phone	Avaya	9650	
MD	10N512508811			IP Phone	Avaya	9650	
MD	13N505402341			IP Phone	Avaya	9650	
MD	12N502501723			IP Phone	Avaya	9650	
MD	2258435			IP Phone	Avaya	9650	
MD	06N507003991			IP Phone	Avaya	9650	
MD	07N547404505			IP Phone	Avaya	9650	
MD	08N521302011			IP Phone	Avaya	9650	
MD	09N546110554			IP Phone	Avaya	9650	
MD	09N552303877			IP Phone	Avaya	9650	
MD	10FA20002142			IP Phone	Avaya	9650	
MD	10FA23004053			IP Phone	Avaya	9650	
MD	10FA23004095			IP Phone	Avaya	9650	
MD	10FA23004097			IP Phone	Avaya	9650	
MD	10FA23004120			IP Phone	Avaya	9650	
MD	10N505506764			IP Phone	Avaya	9650	

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	11N502606290			IP Phone	Avaya	9650	
MD	11N517503600			IP Phone	Avaya	9650	
MD	11N517503700			IP Phone	Avaya	9650	
MD	12N506405049			IP Phone	Avaya	9650	
MD	13N503305580			IP Phone	Avaya	9650	
MD	13N505401426			IP Phone	Avaya	9650	
MD	13N505403114			IP Phone	Avaya	9650	
MD	13N505403124			IP Phone	Avaya	9650	
MD	MMT0BAA0045110B3164201	051458		Monitor	Acer	Acer K272HL	
MD	CN0U828K7444506QFP3S	050812		Monitor	Dell	DELL P2210	7/29/2010
MD	CN0GFXN47444535G521M	051172		Monitor	Dell	Dell P2312H	4/3/2013
MD	CN0GFXN474445325CC1L	051173		Monitor	Dell	Dell P2312H	6/26/2013
MD	CN0TYXD97444511O104L	050865		Monitor	Dell	Dell P2314H	
MD	CN0XTK9N74445282AXDM	051064		Monitor	Dell	DELL P2314H	3/10/2016
MD	CN0XTK9N74445282721M	051065		Monitor	Dell	DELL P2314H	3/10/2016
MD	CN07R1K37444536OA8DL	051142		Monitor	Dell	DELL P2314H	8/23/2013
MD	CN07R1K37444541HGXKL	051160		Monitor	Dell	Dell P2314H	
MD	CN07R1K37444541HGXCL	051181		Monitor	Dell	DELL P2314H	3/7/2014
MD	CN07R1K37444541HGWYL	051182		Monitor	Dell	DELL P2314H	3/7/2014
MD	CN07R1K37444541HGH3L	051239		Monitor	Dell	DELL P2314H	3/7/2014
MD	CN07R1K37444541HGXGL	051243		Monitor	Dell	DELL P2314H	3/7/2014
MD	DD0GR62	051399		Monitor	Dell	DELL P2314H	8/7/2016
MD	CN07R1K374445535C5YB	051406		Monitor	Dell	DELL P2314H	
MD	4D0GR62	051438		Monitor	Dell	Dell P2314H	
MD	GC0GR62	051466		Monitor	Dell	Dell P2314H	4/1/2016
MD	1D0GR62	051467		Monitor	Dell	Dell P2314H	4/1/2016
MD	FD0GR62	051471		Monitor	Dell	DELL P2314H	1/1/2016

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	HD0GR62	051506		Monitor	Dell	Dell P2314H	
MD	CN0R9F1P742614CE21JL	050979		Monitor	Dell	DELL U2414H	
MD	CN0GFXN474445325BKXL	051152		Monitor	Dell	DELL U2414H	
MD	CN07R1K37444541HGX9L	051249		Monitor	Dell	Generic PnP	3/7/2014
MD	CN07R1K37444541HGWZL	051250		Monitor	Dell	Generic PnP	3/7/2014
MD	1412W82	052017		Monitor	Dell	Generic PnP	2/8/2018
MD	U65176H8N155324	052160		Printer	Brother	Brother HL-L3270CDW	
MD	U65176H9N312245	052273		Printer	Brother	debut/1.30	1/10/2020
MD	U64965K8N702674	052158		Printer	Brother	HL-L2370DW	
MD	U64965A9N845198	052272		Printer	Brother	HL-L2370DW	
MD	CNGCND71V7	052796		Printer	HP	CP5225dn	
MD	PHBHB71192	051504		Printer	HP	M402n	2/20/2017
MD	PHGDC45322	051279		Printer	HP	LASERJET PRO 400 M	10/27/2014
MD	VNBRNCS2JT	052599		Printer	HP	M283fdw	
MD	VNBRNCS2GM	052600		Printer	HP	M283fdw	
MD	CNB8H7N6F8	051370		Printer	HP	M476dn	12/24/2015
MD	VNB3T11542	050918		Printer	HP	P2055dn	8/8/2012
MD	VNB3R42043	050936		Printer	HP	LASERJET P2055dn	5/9/2012
MD	8M16KN1	052252	DAR3	Server	Dell	R410	9/15/2010
MD	9DLVM02	052249	DAR13	Server	Dell	R420	5/25/2014
MD	17DPXM2	051597	DAR011 0.35	Server	Dell	R440	2/20/2018
MD	5SP0RN1	052255	DAR8	Server	Dell	R510	9/7/2010
MD	9SWPM02	052251	DAR11	Server	Dell	R520	5/28/2014
MD	GV4R8V1	052253	DARTEST3	Server	Dell	R710	9/11/2012
MD	8M15KN1	052254	DARTEST4	Server	Dell		9/15/2010
MD	2BW2074X0001E	051232		Switch	Netgear	AX742	
MD	24P105490008B	051233		Switch	Netgear	AX742	
MD	24P1054K00005	051234		Switch	Netgear	AX742	

Ben Franklin Transit

EXHIBIT A - LIST OF SURPLUS INFORMATION TECHNOLOGY (JAN 2023)

Last Updated: 1/23/2023

CK	Serial #	Asset Tag	Asset Name	Device Type	Manufacturer	Model	Manufacturer Date
MD	J11684997	051456		VCR / DVD	Sanyo	FWDV225F	3/1/2016

Memorandum

Date: February 9, 2023

To: Rachelle Glazier, General Manager

From: Joshua Rosas, Senior Manager of Fleet and Facilities Maintenance

Re: Informational Report on Fleet Transition

Background

On December 1, 2021, the Federal Transit Administration (FTA) released a Dear Colleague letter outlining requirements for projects related to zero-emission vehicles. The letter stated that these projects must have a Fleet Transition Plan attached to grant applications for consideration.

As part of Ben Franklin Transit's (BFT) commitment to zero-emission vehicle conversion, BFT retained Stantec Consulting Services Inc. to develop a comprehensive analysis of different zero-emission fleet options. Options include battery-electric buses and fuel cell electric buses. The analysis provides power and energy modeling to understand the feasibility of different fleet options and financial analysis.

Current Fleet

BFT currently has 70 diesel buses and 1 electric conversion bus detailed in Table 1. The Battery Electric Bus was converted from diesel to electric in 2012 and put into service in 2013.

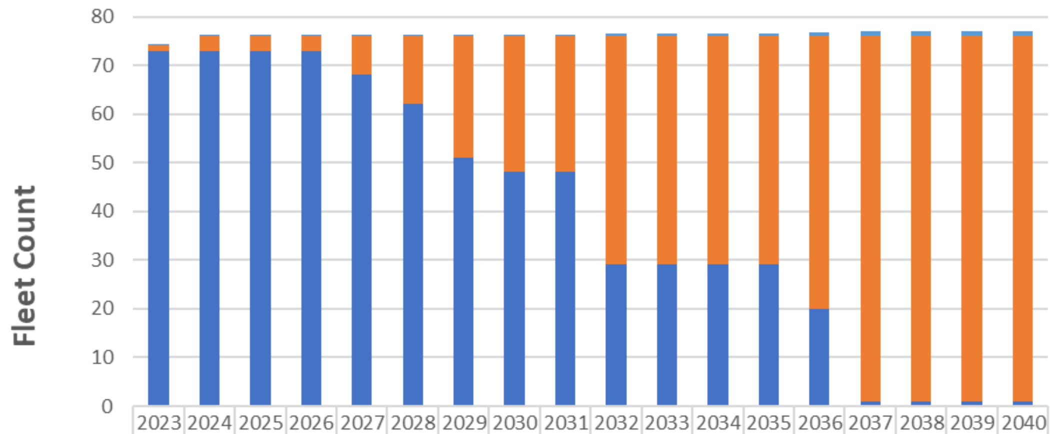
Table 1. Current Fleet

Model Year	In-Service Year	Quantity	Make	Vehicle length	Fuel type	Anticipated Retirement Year	BFT useful life benchmark	Current age
2005	2005	5	40' Gillig Low Floor	2	Diesel	2019	14 years	17
2006	2006	1	40' Gillig Low Floor	40'	Diesel	2020	14 years	16
2007	2007	3	30' Gillig Low Floor	30'	Diesel	2021	14 years	15
2009	2009	7	40' Gillig Low Floor	40'	Diesel	2023	14 years	13
2013	2013	4	40' Gillig Low Floor	40'	Diesel	2027	14 years	9
2013	2013	1	40' Gillig ZEPSLF40E	40'	BEB	2027	14 years	9
2013	2013-2014	6	40' Gillig Low Floor	40'	Diesel	2028	14 years	8
2015	2015	11	40' Gillig Low Floor	40'	Diesel	2029	14 years	7
2016	2016	3	35' Gillig Trolley	35'	Diesel	2030	14 years	6
2018	2018	13	35 Gillig Low Floor	35'	Diesel	2032	14 years	4
2018	2018	6	29' Gillig Low Floor	29'	Diesel	2032	14 years	4
2008	2020	2	40' Gillig Phantom	40'	Diesel	2023	14 years	14
2022	2022	9	40' Gillig Phantom	40'	Diesel	2036	14 years	1
		71						**9.46**

Fleet Transition

While BFT intends to consider all zero-emission vehicle options, Stantec's report (attached) was done solely on fixed-route service. Demand Response services such as Dial-A-Ride (DAR) are less predictable. This proves difficult when not only mileage is considered, but also terrain, when planning for zero-emission technologies. Based on BFT's current planned fleet replacement schedule and future procurements, Table 2 depicts the options for fleet transition.

Table 2. Fleet Transition Options



	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Alternate Fuel Percentage	1%	4%	4%	4%	11%	18%	33%	37%	37%	62%	62%	62%	62%	74%	99%	99%	99%	99%
Alternate Fuel Buses	1	3	3	3	8	14	25	28	28	47	47	47	47	56	75	75	75	75
Diesel Buses / Minibuses	73	73	73	73	68	62	51	48	48	29	29	29	29	20	1	1	1	1

2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
5	6	11	3	0	19	0	0	0	9	19	0	0	0

The strategy identified by BFT allows us to thoroughly test incoming battery electric buses while waiting for advancements in alternative-fuel technologies. With input from the Board and staff, BFT can make informed decisions on future vehicle procurements. Taking a conservative approach is important, as it allows time for infrastructure to be implemented and ensures compliance with FTA useful-life requirements. As our diesel buses meet useful life, BFT can replace them with alternative-fueled vehicles as funding allows. Having a mixed fleet is recommended across the industry; agencies are still able to provide crucial services through major events.

Alternative-fuel technologies are in a period of rapid development and change. While the technology is proven in many pilot deployments, it has not yet matured to the point where it can reliably replace diesel buses. Battery electric buses will require significant investment in facilities and infrastructure and may require changes to service and operations to manage their inherent constraints. Buses powered by hydrogen are being deployed across the transit industry; however, our area doesn't currently have infrastructure to support hydrogen production.

<u>Funding</u>

Budgeted: NA
Budget Source: NA
Funding Source: NA

<u>Recommendation</u>

Provide Board input on fleet transition options.

Forwarded as presented:

____

Rachelle Glazier, General Manager

Fleet Strategy and Final Report

Ben Franklin Transit Fleet Rollout and Implementation Plan

Final Report

December 16, 2022

Stantec

Fleet Strategy and Final Report

Fleet Rollout Plan and Analysis Services

December 16, 2022

Prepared for:

Ben Franklin Transit

Prepared by:

Stantec Consulting Services Inc.

FLEET STRATEGY AND FINAL REPORT

Release Version

Rev.	Description	Date
0	Draft Report Issued to BFT	9/23/2022
1	Revised Report Issued to BFT	12/08/2022
2	Final Report Issued to BFT	12/16/2022

Project Team

Stantec Consulting Services Inc.

801 South Figueroa Street Suite 300

Los Angeles CA 90017-3007

Table of Contents

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Ben Franklin Transit (BFT) is the largest public transportation provider in Southeastern Washington, providing fixed route, Dial-A-Ride, vanpool, and demand response service to the cities of Kennewick, Pasco, Richland, West Richland, Benton City, Prosser, and Finley.

Stantec Consulting Services Inc. (Stantec) was retained by BFT to develop a zero-emissions bus (ZEB) transition strategy to guide BFT's planning, procurement, and deployment of ZEBs and related infrastructure. Through several analyses, including route modeling and bus simulations, and stakeholder engagement with BFT staff, Stantec initially developed a feasible framework to deploy a fleet of 100% BEBs by 2040. However, upon further discussion and steering, we developed a preferred alternative of replacing 25% of BFT's diesel bus fleet with alternative fuel buses, whether battery-electric or hydrogen fuel cell-electric buses, by 2040 to present a more conservative approach. This approach will help balance the challenges related to financial and economic elements, as well as operational considerations.

While the preferred concept is restrained, we also designed a 100% transition to provide BFT with a blueprint for how it *may* achieve 100% battery-electric fleet. The analysis and site designs presented here in this report can be used by BFT for grant applications, budgeting, and to inform capital planning.

In the 100% BEB scenario, scenarios were developed to include on-route charging to overcome range limitations of BEB vehicles. Furthermore, we developed site designs and outlined electrical needs for this scenario that informed cost estimates for the transition plan.

Overall, implementing the ZEB fleet could cost $128M (cumulative capital and operating costs) compared to $102M for business-as-usual (fossil fuel technology) within a 17-year timeframe (through 2040). Stated otherwise, the transition to ZEBs adds incremental capital and operating costs of $26M over the 17-year period. The infrastructure requirements are also captured in this plan to accommodate the phased acquisition of BEBs while still operating and eventually phasing out fossil fuel vehicles. Actual costs will depend strongly on economic pressures, grant availability, and actual transition to different technologies. With a full transition to BEBs and accounting for upstream energy-related emissions, BFT can reduce its fleet-related greenhouse gas emissions by approximately 95% (~9,160 tons annually).

Taken together, this document provides a framework for BFT to implement ZEBs through 2040, while the project process has generated data and valuable information that BFT can use as source material when applying for grants, adjusting operations, and a whole host of other elements.

Abbreviations

AHJ	Authorities Having Jurisdiction
AQMD	Air Quality Management District
ASC	AMPLY Site Controller
AVTA	Antelope Valley Transit Authority
BEB	Battery electric bus
BESS	Battery electric storage system
BFT	Ben Franklin Transit
BUILD	Better Utilizing Investments to Leverage Development
CMS	Charge management system
DGE	Diesel gallon equivalent
EVITA	Energy Northwest's Electric Vehicle Infrastructure Transportation Alliance
ESS	Energy Storage System
FCEB	Hydrogen fuel cell electric bus
GHG	Greenhouse gas
HVDC	High-voltage direct current
IC	Internal combustion
KTC	Knight Street Transit Center in Richland
LPG	Liquid petroleum gas
NFPA	National Fire Protection Association
NREL	National Renewable Energy Laboratory
NTI	National Transit Institute
OCPP	Open Charge Point Protocol

OEM	Original Equipment Manufacturers
PPE	Personal protection equipment
PUD	Public Utility District
PV	Photovoltaic
SOC	State of charge
TRTC	Three Rivers Transit Center in Kennewick
TOU	Time of use
TTC	Toronto Transit Commission
ZE	Zero emission
ZEB	Zero-emission bus
22TC	22nd Ave Transit Center in Pasco

1.0 INTRODUCTION

Ben Franklin Transit (BFT) provides public transportation in Benton and Franklin Counties along the Columbia River. BFT is the largest public transportation provider in southeastern Washington, providing over 3.1 million unlinked passenger trips in 2019[1]. BFT operates under the mission statement "to provide exceptional and cost-effective transportation services that consistently exceed customer expectations while promoting the principles and practices of livable communities and sustainable development." To this end, BFT is developing a strategic plan to transition their current fleet of diesel-powered buses to a fleet of zero-emission buses (ZEB).

BFT's current fixed-route revenue service fleet is comprised of 70 full-size buses (between 29-ft. to 40-ft.), all of which use diesel and one 40-ft battery electric bus (BEB). This BEB is now obsolete and served as an early pilot of ZEB technologies. The scope of this study is fixed route services and vehicles.

BFT operates in a large service area that covers multiple utility jurisdictions. As instrumental partners in transitioning to ZEBs, utility providers are involved in every step from planning to implementation and commissioning. Utilities in Benton and Franklin Counties include Benton Public Utility District (PUD), Benton Rural Electric Association, Franklin PUD, and Richland Electric which are all part of the Energy Northwest's Electric Vehicle Infrastructure Transportation Alliance (EVITA).

This document provides a strategic framework of the technology, needs, and strategies that can help BFT transition to a ZEB fleet. To develop this rollout plan, several steps have been taken to determine potential strategies for BFT's ZEB adoption. These steps include:

- A review of existing conditions to understand characteristics and constraints for BFT's operations and service area. This included a primer on different ZEB technologies to provide a scan of the market and technologies, including battery-electric buses (BEBs) and hydrogen fuel cell electric buses (FCEBs).
- Energy and power modeling to understand the viability of different ZEB technologies and their implications for BFT's service delivery.
- A quantitative and qualitative assessment of modeling results, together with staff engagement, to determine the potential ZEB fleet composition for BFT.

The ZEB fleet alternative for BFT is fleet composed of 25% of alternative fuel buses by 2040. BFT will start deployment of a small number of BEBs in 2024 and will monitor performance and can use much of the analysis conducted throughout this study along with first-hand experience to refine the approach and technology choice(s) for alternative fuel ZEBs. The actual speed of deployment will depend strongly on the financial impacts of deploying ZEBs and funding availability. This document also provides detailed information about a *potential* implementation and phasing strategy to get BFT to 100% ZEBs through

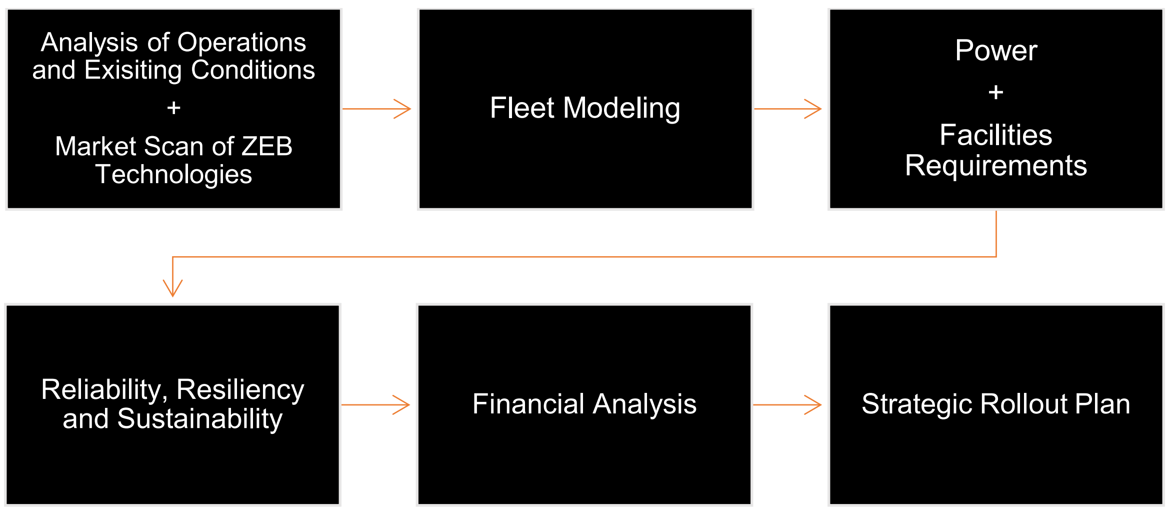
[1] NTD 2019 agency profile

2040. **Importantly, this plan is a framework and should be considered a living document to be revisited and revised as technologies continue to mature, funding priorities and realities shift, and service design and delivery change to better reflect the travel needs of the community.**

2.0 APPROACH TO ZEB PLANNING

The graphic in Figure 1 provides a high-level schematic of the major steps in this project to derive a recommended fleet concept and develop an implementation plan.

Figure 1: Schematic representation of the steps in the ZEB planning process



The first step involved a review of existing conditions of BFT's fleet, facilities, and service delivery to provide a foundation and understanding of BFT's operations and business processes that would be impacted by a transition to a ZEB fleet. A summary of these key findings is provided in Section 3.0. A site visit of the operating base and maintenance facility in Richland provided insights into the constraints and opportunities for implementing ZEBs, as well as the condition of the facilities, buildings, and existing service cycle. A market scan was also conducted to analyze the current ZEB technologies, their limitations, and in-development technologies that can help shape BFT's future ZEB fleet.

Next, we used computer modeling to simulate the performance of BEBs and FCEBs on BFT's service blocks and vehicle assignments. The modeling provided predicted performance, including fuel economy, operating ranges, and feasibility of the different ZEB technologies. The analysis revealed that BEBs would struggle to deliver a significant amount of BFT's service and could not replace diesel buses in a 1:1 manner; FCEBs could achieve a greater level of electrification. However, other factors were also considered, such as scheduling and operations, fuel supply chains, and stakeholder feedback from BFT staff to help shape the preferred ZEB alternative. We considered on-route BEB recharging at strategic transit hubs throughout BFT's network as a way to enable the BEB transition. The modeling process, preferred fleet alternative, and charging profile and projected power demand is summarized in Section 4.0.

Subsequently, working with BFT staff, we developed a fleet transition/implementation plan that transitions diesel buses to BEBs, along with a phasing strategy for chargers and facility modifications.

Section 4.4 describes the fleet and facility phasing strategy, Section 6.0 describes the conceptual site plans and the modifications required at the operations and maintenance facility, and Section 7.0 describes the modifications required at the transit centers to accommodate on-route charging. Moreover, the information related to FCEBs can help guide BFT if hydrogen fuel supply, in the longer term, becomes less of a barrier and BFT decides to pursue hydrogen FCEB technology.

With the site plans and identification of required facility modifications and impacts on capital and operating costs, Stantec developed a financial analysis for the ZEB rollout through 2040 (Section 9.0). Operating and planning considerations (Section 10.0, 11.0), workforce training (Section 12.0), and potential funding sources (Section 13.0) are also reviewed and discussed.

3.0 SUMMARY OF KEY EXISTING CONDITIONS

The first step in developing a ZEB transition strategy involves analyzing current operating conditions to understand operating parameters and practices that need to be modified for fleet electrification. Furthermore, a condition assessment of the operating facilities was also conducted to understand the modifications that may need needed to accommodate a ZEB fleet.

Major findings from the existing conditions analysis include:

- BFT's fixed route fleet includes a combination of 70 29-ft, 30-ft, 35-ft, and 40-ft buses that are all diesel-powered with the exception of one BEB that was put into service in 2013. The sole BEB is not used on regular service. The majority of BFT's fleet are within their useful life benchmarks and operating in a state of good repair.
- BFT assigns one bus per service block, and no buses complete multiple blocks in a day. BFT's operations are characterized by vehicles operating long blocks along a single route that are in service for 12+ hours a day. Blocks are very long, averaging 228 miles, which could pose challenging to convert to ZEBs on a one-to-one basis given current ZEB mileage and range constraints.
- Limited improvements to the actual building would likely be required to accommodate either type of ZEB technology, with the exception of the need to upgrade the building exhaust systems, formal fall protection system for accessing rooftop equipment, and a new gas-detection systems for potential hydrogen fuel. In addition, the necessary tools and specialty diagnostic equipment would be required for either type of vehicle, and would be implemented at the time staff are trained to service the particular vehicle.

3.1 OPERATIONS AND SERVICE

BFT operates several different transit services for Benton and Franklin Counties. BFT operates 18 fixed routes to various communities including Kennewick, Pasco, Richland, West Richland, Benton City, Prosser, and Finley. Most routes operate Monday through Saturday, with METRO Route 1 and METRO Route 2 offering service on Sundays. School trippers operate on routes 123, 26, and 225 to alleviate congestion on buses at the beginning and end of the school day.

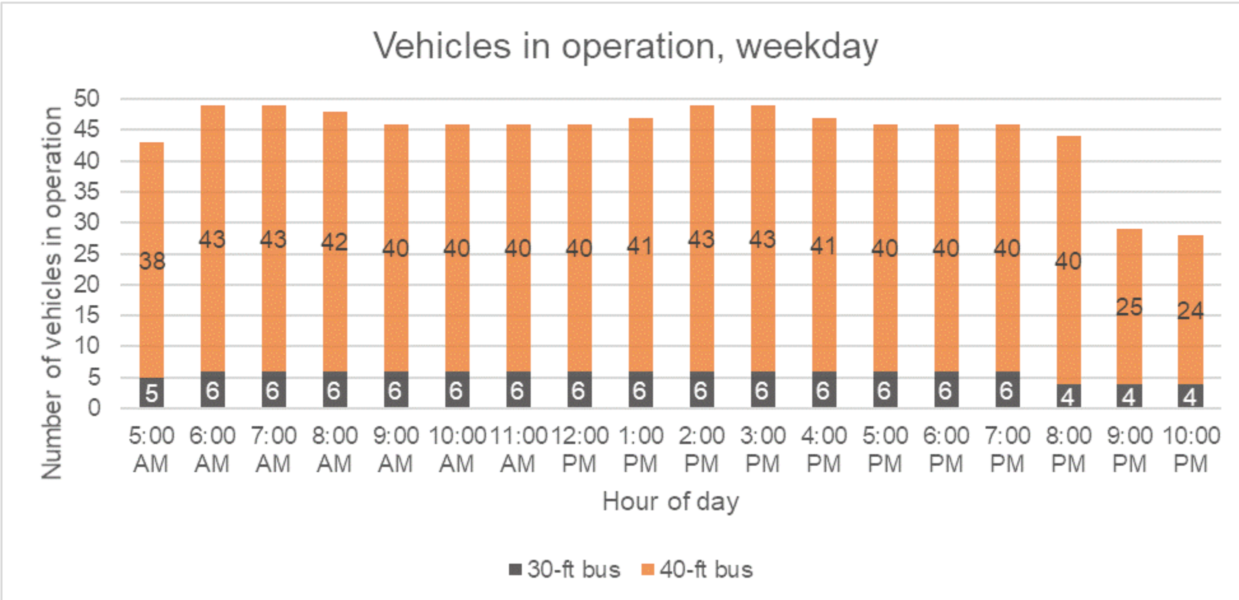
BFT's current fixed-route revenue fleet is comprised of 70 full-size buses (between 29-ft. to 40-ft.), all of which use diesel (Table 1) and one 40-ft. BEB. Most vehicles are within their useful life benchmarks as specified by BFT and the Federal Transit Administration (FTA). The table also shows the anticipated replacement with alternative fuel ZEBs. In the short-term, BFT will deploy two BEBs within the next several years.

Table 1: Current fleet and ZEB considerations

Model Year	In-Service Year	Quantity	Make	Vehicle length	Seating capacity	Fuel type	Anticipated BFT replacement year
2013	2013	8	40’ Gillig Low Floor	40’	37	Diesel	2023
2013	2013	1	40’ Gillig ZEPSLF40E	40’	38	BEB	2025
2014	2015	6	40’ Gillig Low Floor	40’	37	Diesel	2025
2015	2016	7	40’ Gillig Low Floor	40’	37	Diesel	2026
2016	2016	3	35' Gillig Trolley	35'	30	Diesel	2027
2018	2018	10	35' Gillig Low Floor	35’	30	Diesel	2028
2018	2018	6	29’ Gillig Low Floor	29’	23	Diesel	2029
2018	2018	3	35' Gillig Low Floor	35’	30	Diesel	2029
2024	2024	2	40' Gillig BEB	40'	37	BEB	2036
2022	2022	9	40’ Gillig Low Floor	40’	37	Diesel	2036
2023	2023	14	40’ Gillig Low Floor	40’	37	Diesel	2037
2024	2024	5	35' Gillig Low Floor	35’	30	Diesel	2038

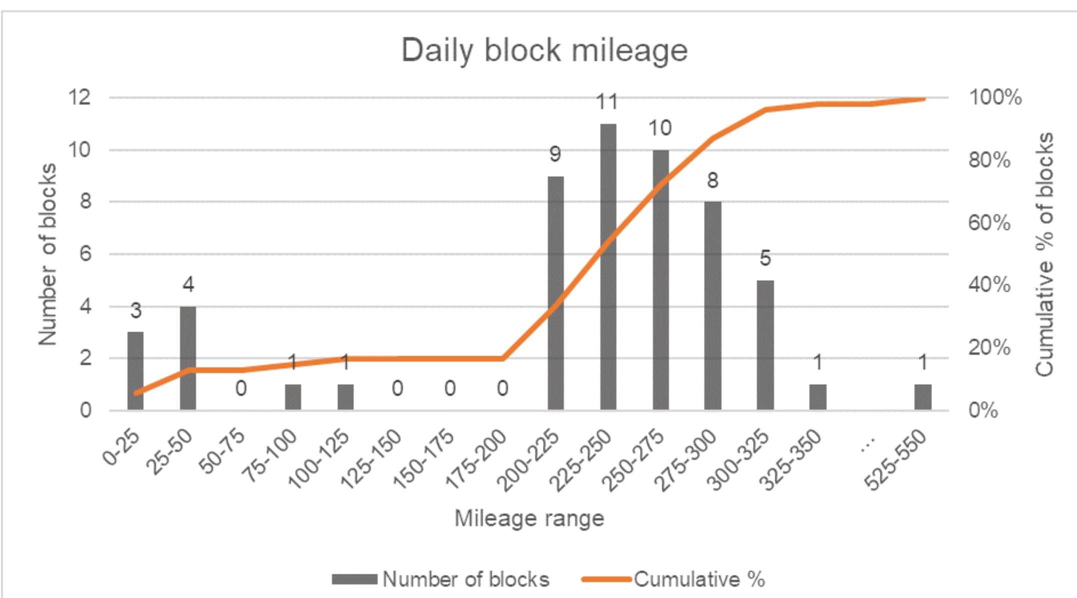
Figure 2 shows that BFT’s vehicles tend to be in continuous operation for the majority of the day, rather than displaying significant AM and PM peaks during rush hour as seen by other agencies or services geared towards commuters. Service peaks at 49 vehicles in operation at several points throughout the day (6am, 7am, 2pm, and 3pm), which show slight peaks when more vehicles are in service to provide additional capacity for school trippers.

Figure 2: Hourly weekday vehicle requirements



Based on an analysis of service block mileage, BFT's vehicles operate between 20 to over 500 miles in a day, and 83% of service blocks travel more than 200 miles in a day. This analysis, shown in detail in Figure 3, demonstrates that BFT may face significant challenges when trying to electrify operations with ZEBs in a one-to-one manner with traditional diesel buses. Options such as on-route/opportunity charging, midday charging/refueling, or reblocking service to accommodate ZE operations, are all options that can be explored to make the ZEB transition possible.

Figure 3: Block frequency by daily service miles



3.2 MAINTENANCE FACILITY

The administrative and maintenance buildings on the property were not specifically assessed as part of this report but are in good condition. The facility meets BFT's current operational and maintenance functions but is essentially at full capacity with limited opportunity for fleet expansion. The maintenance building has 6 drive-through large vehicle maintenance bays at the east end of the maintenance shop and 6 small vehicle maintenance bays at the west end of the shop. The maintenance facility seems to be adequate for the current fleet of diesel buses and non-revenue vehicles. Most bays feature vehicle lifts with the exception of the three inspection pits on the east end. The maintenance bays have a central circulation aisle with overhead doors on the outside of each bay. The shop is configured to be drive-through for all bays except for the chassis wash and body bays. Vehicle exhaust reels and other typical vehicle maintenance equipment was generally observed at the facility but was not assessed as a part of this study.

Figure 4: Aerial image of facility (source: Google Maps)

Overall, the existing conditions lay the groundwork for future steps of the ZEB analysis, and the major findings and takeaways presented in the Existing Conditions Report provided insights into the constraints and opportunities regarding modeling, fleet composition, future ZEB infrastructure requirements, and financial impacts.

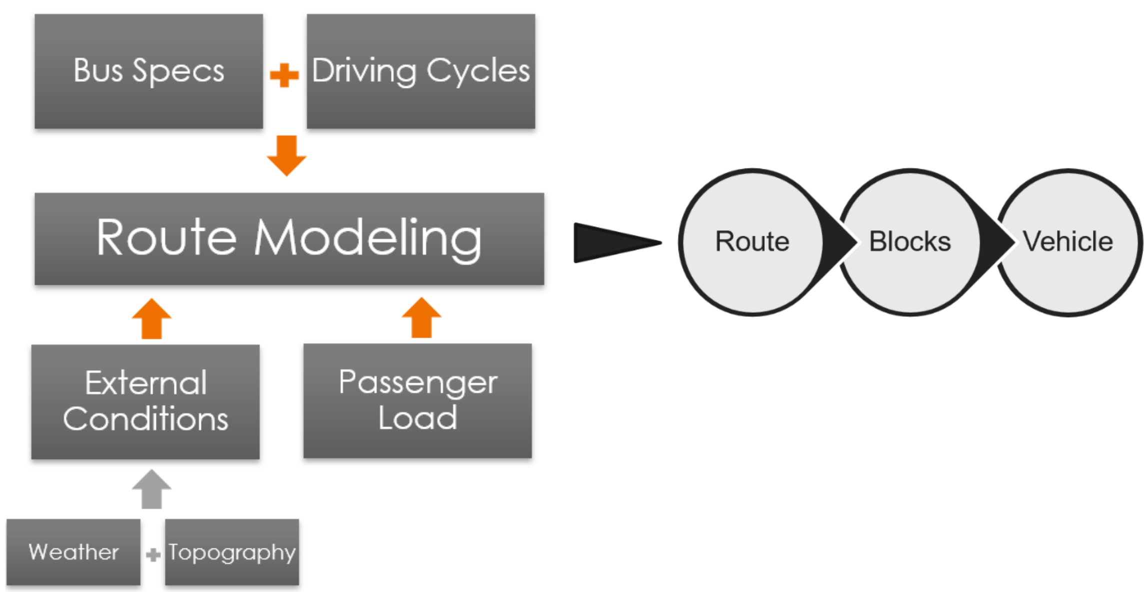
4.0 ROUTE MODELING & PREFERRED FLEET ALTERNATIVE

This section provides an overview of the power and energy modeling methodology and presents the results of the modeling to understand the feasibility of transitioning BFT's operations to different ZE alternatives. Based on the modeling outcomes, we present a discussion of the different ZE fleet solutions and the pros and cons of different fleet compositions which were used to determine the preferred ZEB fleet composition for BFT's fixed-route fleet.

4.1 FLEET AND POWER MODELING OVERVIEW

ZEVDecide, Stantec's fleet modeling tool, was used to determine the feasible and preferred ZEB composition for BFT's fleet. The predictive ZEB performance modeling (schematic overview shown in Figure 5) depends on several inputs, such as passenger loads, driving cycles (or duty cycles), topography, vehicle specifications, and ambient conditions subject to the environment in which the agency operates.

Figure 5: ZEVDecide modeling overview



Modeling Inputs

ZEVDecide's modeling process predicts ZEB drivetrain power requirements specific to given acceleration profiles. The following inputs are included in the model to determine the feasibility of different ZEB technologies under BFT's operating conditions:

Bus/vehicle specifications: the bus specification inputs used in the modeling are shown Figure 6. For BFT, the key BEB specifications used in the modeling process for each service type are shown in Table

2. These specifications are based on currently available models and available information. Both BEBs and hydrogen fuel cell electric buses (FCEBs) are only currently available in 35-ft. and 40-ft models. Table 3 provides the key FCEB specification inputs used in the modeling process.

Figure 6: Schematic of the inputs for bus specifications.

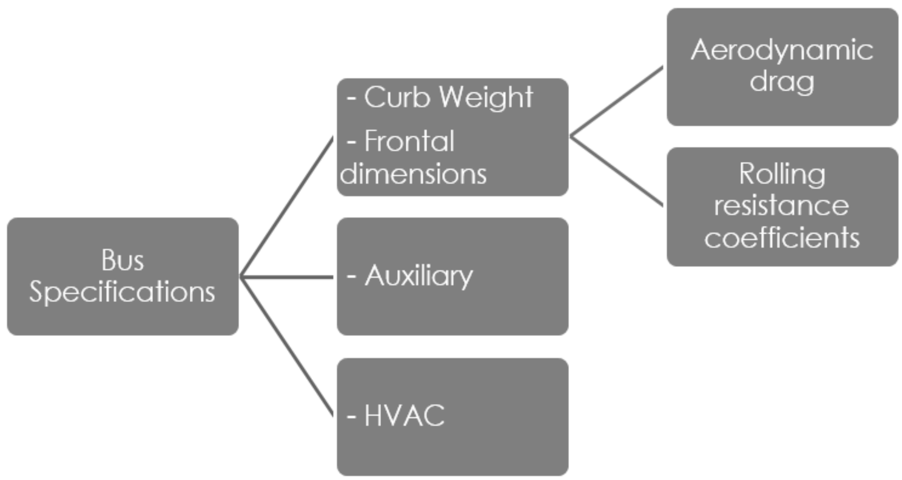


Table 2: BEB specifications for energy modeling

BEB Model	30-ft.	40-ft	40-ft (extended range)
Modeled battery size (kWh)	450	525	675
Modeled curb weight (lbs.)	29,700	33,000	45,000

Table 3: FCEB specifications for modeling

FCEB Model	35-ft.	40-ft	40-ft (extended range)
Modeled tank size (kg)	35	37.5	50
Modeled curb weight (lbs.)	29,700	40,000	45,000

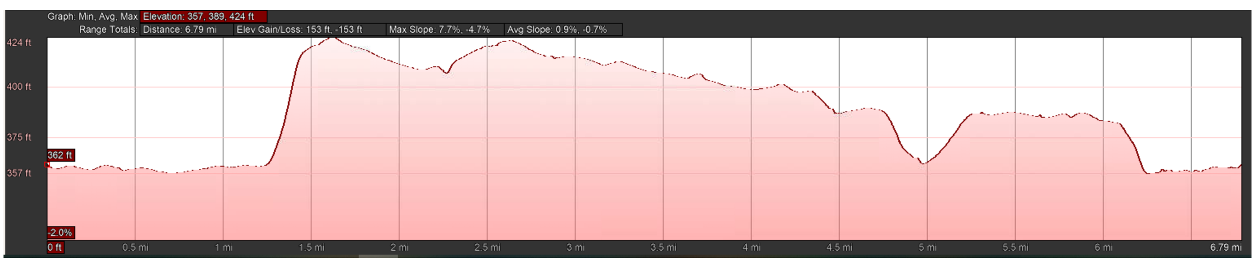
Representative driving cycles: also called acceleration profiles or duty cycles, representative driving cycles are speed versus time profiles that are used to simulate vehicle performance and energy use. Cycles were assigned to all routes based on BFT's operations and observed driving conditions and are derived from the National Renewable Energy Laboratory's (NREL) drive cycle database called DriveCAT[2]. Some routes were assigned two driving cycles to simulate different driving conditions across different parts of the route. The complete assignment of driving cycles to all routes is presented in the Energy Modeling Report.

Passenger loads: to examine the weight-associated impacts of passenger loads experienced by BFT's fleet, we used actual BFT loading data for each trip during a typical service day. BFT provided data for each route detailing the passenger load for each route to be modeled. Modeled passenger loads for each route are detailed in the Energy Modeling Report.

Ambient temperature: Stantec developed a correlation between ambient temperature and power requirements from the HVAC system. The power requirement for modeling purposes was set based on an annual low-temperature average of 42°F[3].

Topography and elevation: given that portions of BFT's service area are highly impacted by elevation and topography, it is important to account for the impacts of terrain and elevation on the energy efficiency of ZEBs. Each route alignment was imported into Google Earth to create an elevation profile to understand the total elevation gains/losses seen for each route in the system (see example in Figure 7).

Figure 7: Elevation profile example (Route 25)



Source: Google Earth

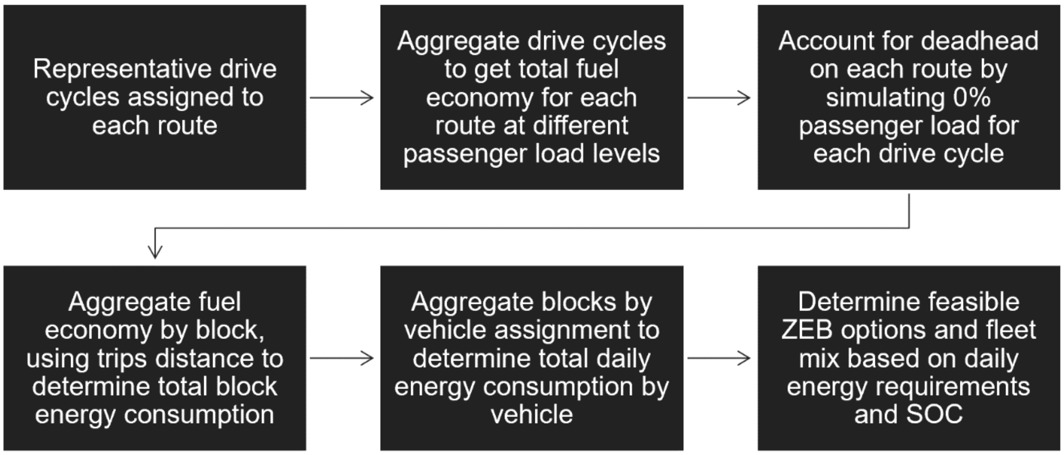
Modeling Process

Using the inputs above, predictive power and energy modeling was completed for fixed-route services. The energy modeling process for fixed-routes first aggregates results at the route level, then at the block level, and is then aggregated at the vehicle assignment level to determine total daily energy consumption per vehicle. This process is schematized in Figure 8.

[2] NREL DriveCAT - Chassis Dynamometer Drive Cycles. (2019). National Renewable Energy Laboratory. www.nrel.gov/transportation/drive-cycle-tool

[3] US Climate: https://www.usclimatedata.com/climate/richland/washington/united-states/uswa0373

Figure 8: ZEVDecide energy modeling process



The results of the modeling provide insight into:

- Fuel economy and energy requirements
- Operating range
- The feasibility of a BEB to complete its assigned service by estimating the state of charge (SOC); the vehicle assignment can be successfully completed with a BEB if it can complete its scheduled service with at least 20% battery SOC remaining. For FCEBs, if a bus consumes less than 95% of its tank capacity, the vehicle assignment is counted as successful.

On-Route Modeling Process

When modeling BEBs, the starting assumption is that the vehicles will only charge overnight (aka in-depot charging), and the daily assignment is considered successful if the vehicle completes its scheduled service with at least 20% battery state of charge (SOC) relying solely on that one overnight charge. However, if any vehicle assignment was unsuccessful with only in-depot charging, the alternative of using fast charging while the bus is on-route was explored during scheduled layover times at transit centers—referred to henceforth as "on-route charging"[4].

On-route charging is usually provided by high-power chargers (>300 kW) using overhead pantographs that lower onto charge rails mounted on the roof of the bus (see Figure 9). On-route charging effectively recharges or "tops up" a bus in as little as five minutes, providing additional driving range; subsequently, the BEB can complete additional trips before requiring additional recharging.

[4] On-route charging typically occurs during layovers, and is sometimes referred to as opportunity charging or recharging.

Figure 9: Overhead pantograph charger lowering onto a BEB for on-route charging (Los Angeles Metro)

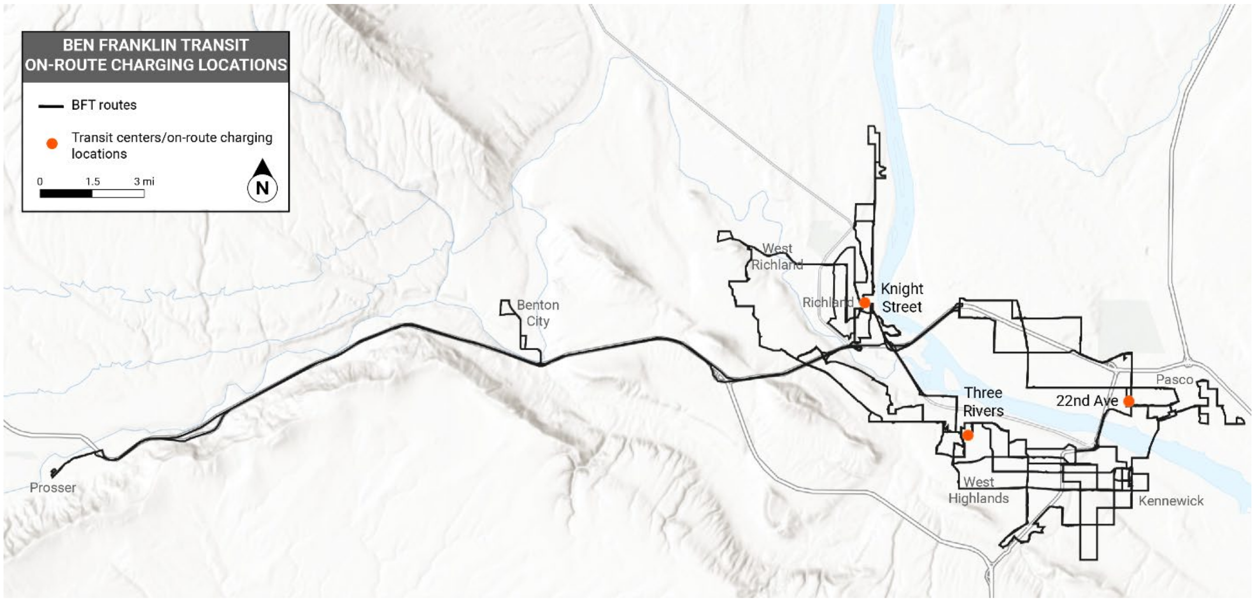
The methodology used for on-route modeling considers existing blocks and identifies currently scheduled layovers. Layovers that can be utilized for on-route charging generally include layovers that are five minutes or longer. This time window provides enough time for the bus to align with the charger, receive a significant charge, and depart the charger within the allocated time.

High-power overhead chargers are costly and complex pieces of equipment to install. As such, the goal was to use the route and bus modeling to understand the minimum number of on-route chargers needed to be deployed across BFT's network to minimize costs while enabling a successful transition to BEBs.

The modeling identified when and where it is most efficient for each vehicle to utilize a layover or recovery to recharge while attempting to minimize peak power requirements and spread charging events throughout the day as much as possible. Charging events can happen at any point in the day given a vehicle's SOC is between 80% and 10% to ensure the battery can receive a charge and to avoid falling below the OEM's recommended minimum SOC to preserve battery life. As such, vehicles may not necessarily charge during every layover event.

Three transit centers were identified where on-route charging could occur for all vehicles that fail with in-depot charging only: the Knight Street Transit Center in Richland (KTC), 22nd Ave Transit Center in Pasco (22TC), and the Three Rivers Transit Center in Kennewick (TRTC) (see Figure 10). These transit centers were strategically chosen as they are owned by BFT, reducing permitting and jurisdiction complexities, as well as because they are the anchors of BFT's network, with all routes passing through or terminating at one of these terminals.

Figure 10: Potential on-route charging locations



The following assumptions were included in the on-route modeling process:

- Layover times as presented in current transit schedules are accurate.
- All layover times of at least five minutes are viable options for an on-route charging event.
- Total on-route charging time for each vehicle was constrained to provide each vehicle with at least 10% SOC at the end of the day when the vehicle would then return to the depot. In-depot charging would occur overnight to refill the battery to 90% SOC before it resumes service the next morning (i.e., on-route charging occurs in addition to in-depot charging). For simplicity purposes, the evaluation criteria for a successful conversion of a block evaluated that the vehicles would need to complete service with no less than 20% SOC left on the battery at the end of the day (since 10% needs to be left in the battery and the battery won't charge beyond 90%).
- A minimum power rating of 350 kW was assumed for the on-route chargers. Increasing the power rating of the units will reduce the charging time but would require BEBs to be procured with the appropriate maximum overhead charging specifications from the OEMs as the current standard is usually below 350 kW.
- Charging at each transit center was spread out throughout the day to minimize peak power requirements at any one time by avoiding simultaneous charging events to the extent possible.
- **Currently, standard outfitting for 30-ft BEBs does not include overhead charge rails.** To reach 100% electrification under a scenario with both in-depot and on-route charging, BFT would need to have a special procurement from an OEM that can install overhead charging equipment on 30-ft BEBs, or BFT would need to procure 35-ft BEBs (which are available with charge rails) to

replace the current 30-ft bus fleet. Alternatively, BFT would need to either reblock services assigned 30-ft buses to operate within the operating range limits accommodated by in-depot charging only or increase the number of 30-ft buses in the fleet to complete the service as it is currently scheduled. **For the purposes of modeling, we assumed that 35-ft BEBs with overhead charge rails would operate on routes 110 and 123 which are currently operated with 30-ft buses.**

Modeling Results

Following the assignment of driving cycles to routes and aggregating these to determine the total fuel economy for each route at different passenger loads, the next step is to determine successful rates and energy consumption at the block and vehicle assignment level, as described in the On-Route Modeling Process section. Modeling results are presented by vehicle type and technology type in this section.

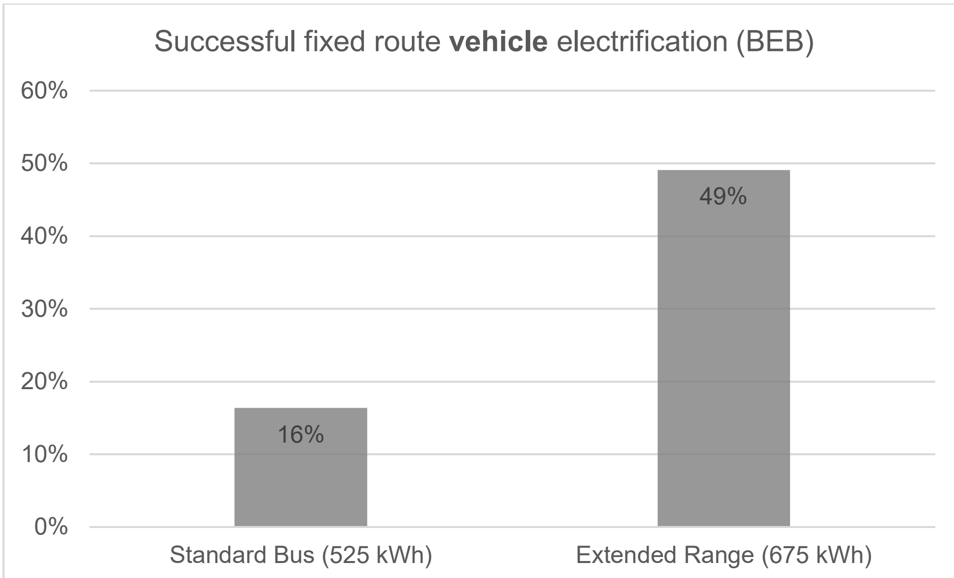
The overall energy or fuel demand per block was obtained by aggregating the fuel consumption from each trip according to the route-level results. The criteria to determine if a block can be successfully served by a BEB is if the SOC of the battery is above 20% after completing all the trips in a block[5], and for FCEBs, the criterion for success is whether a bus consumes less than 95% of its tank capacity.

BEB Depot-Only Modeling Results

Block-level modeling results are shown for BEBs in Figure 11. First, blocks were modeled with smaller battery sizes of 525 kWh (left bar, Standard Bus), and if a block assigned to a 40-ft bus was unsuccessful with the smaller battery size, it was then modeled with a larger 675 kWh battery (right bar, Extended Range bus). Blocks that require the use of a 30-ft bus cannot be modeled with a larger battery pack since 30-ft BEBs are not commercially available with battery packs larger than ~450 kWh.

[5] OEMs recommend that a BEB charge only to 90% of its total battery capacity and not drop below 10% state of charge (SOC) to preserve battery life; dipping below 10% can void the battery warranty.

Figure 11: Successful vehicles that can be served by BEB equivalents



These results in Figure 11 indicate that without a larger battery size, only a small portion of vehicles (16%) can be successfully electrified. All blocks that use 30-ft buses were unsuccessful and no option for larger batteries currently exists. By modeling blocks operating with 40-ft buses with larger battery sizes, the success rate increased to 49%.

Table 4Table 4 summarizes the average fuel efficiency for 40-ft and 30-ft BEBs.

Table 4: Average fuel efficiency for fixed route BEB modeling results

Vehicle type	Average fuel efficiency (kWh/mi)
40-ft bus (both 525 and 660 kWh, as appropriate)	2.23 kWh/mi
30-ft bus (450 kWh)	2.15 kWh/mi
Overall	2.21 kWh/mi

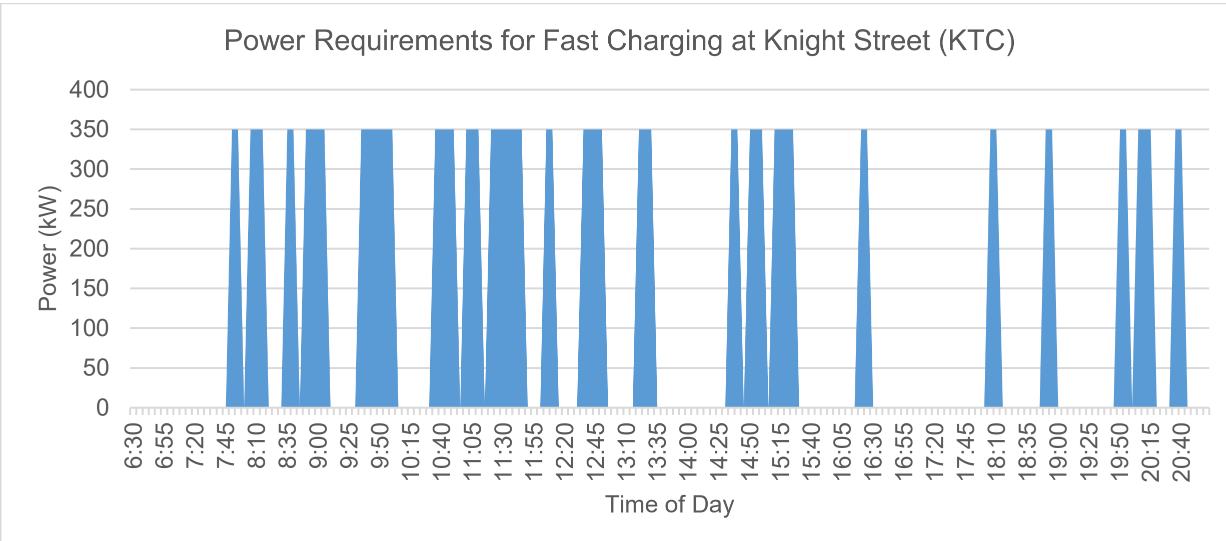
Blocks that fail due to operating ranges that exceed the feasible range of BEBs with in-depot charging only could be successfully electrified with on-route charging, as described in the next section.

BEB On-Route Modeling Results

Based on the low electrification success rate for BEB depot-only charging, the use of on-route charging was added to the analysis to increase the driving range of the vehicles. The modeling approach applied to obtain results for on-route charging is described in Section 4.1.

The Knight Street Transit Center (KTC) was selected to provide on-route charging during layovers for routes 1, 26, and 170 since certain blocks of these routes are not successful with depot-only charging. Figure 12 shows at what point during the day buses operating on these failing blocks would utilize an on-route charger at KTC and provides the expected minimum power requirements at the transit center.

Figure 12: Power requirements for on-route charging at Knight Street Transit Center

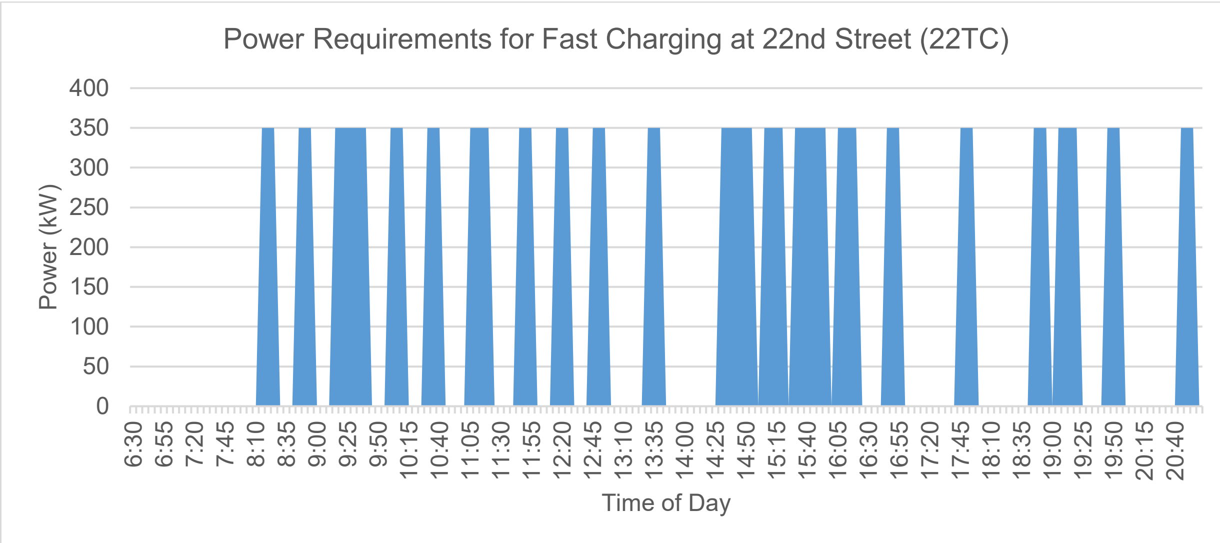


The analysis shows that one fast-charging unit of 350 kW is needed to actively recharge vehicles throughout the day; nevertheless, operationally, one spare charger should be installed at the KTC for redundancy in case of equipment failures, and/or if buses fall behind schedule affecting the availability of the primary charger.

The analysis also revealed that the layovers of block 170-1 would not be long enough to accommodate the needed on-route charging at KTC. To successfully electrify this block, the layover time would need to be increased (from 12 minutes to at least 21 minutes) each time the bus reaches the transit center, or an additional vehicle could be deployed to accommodate the limited range of BEBs, i.e., operating block 170-1 with two vehicles instead of one.

The modeling of bus routes servicing the 22nd Street Transit Center (22TC) revealed that certain unsuccessful blocks of routes 64, 67, 225, and 268 would require on-route charging. Figure 13 shows the expected minimum power requirements at the transit center and the charging events throughout the day.

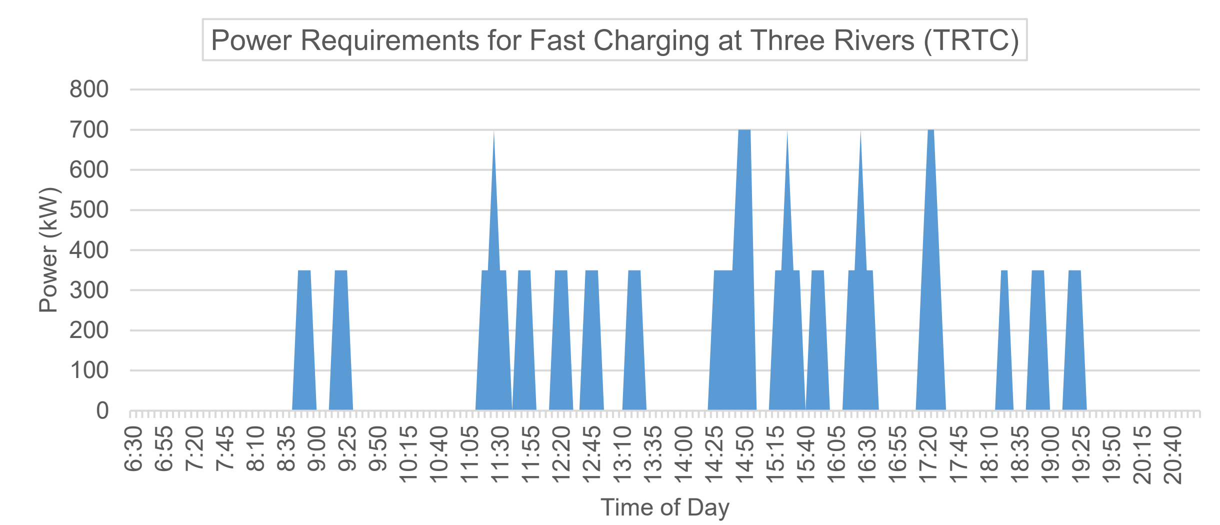
Figure 13: Power requirements for on-route charging at 22nd Street Transit Center



Similar to KTC, the analysis shows that one fast-charging unit of 350 kW is required, based on the modeling to successfully operate the service. However, BFT should consider installing an additional back-up charger as well.

The Three Rivers Transit Center (TRTC) was selected to provide on-route charging to failing blocks of routes 41, 47, 48, 110, and 123 during their scheduled layovers. Figure 14 shows how TRTC has a higher maximum required power than the other two transit centers.

Figure 14: Power requirements for on-route charging at Three Rivers Transit Center



Given that more routes require charging at this location (5 routes versus 3 or 4 routes at the other transit centers) and that layover times tend to overlap more often, more than one primary on-route charger at this location is required. Mid-morning and afternoon spikes in power demand result from overlapping vehicles assigned to blocks to require concurrent charging, and as such, the TRTC requires at least two fast-charging units to accommodate simultaneous charging events. A third fast-charging unit is recommended at TRTC if added redundancy is desired. However, since only 14% (8 out of 55 occurrences) of the charging events at the center would occur simultaneously, if one of the chargers fails, service will not fully be interrupted for this transit center.

A summary of the routes that require on-route charging at each transit center is presented in Table 5, and details of each block are presented in Table 6.

Table 5: List of Routes Requiring On-Route Charging

KTC	22TC	TRTC
1	64	41
26	67	47
170	225	48
	268	110
		123

Table 6: List of Blocks Requiring On-Route Charging

KTC	22TC	TRTC
1-1	64-1	41-1
1-2	64-2	47-1
1-3	67-1	47-3
1-4	225-1	48-2
1-5	225-2	110-1
1-6	225-3	110-2
26-1	268-1	123-1
26-2	268-2	123-2
170-1	268-3	123-3
		123-4

FCEB Modeling Results

Next, the fixed-route service was modeled with hydrogen FCEBs. Figure 15 shows the block and vehicle-level results for FCEBs. Blocks were first modeled with smaller hydrogen tanks of 37.5 kg (left bar, Standard Bus), and if a block assigned to a 40-ft bus was unsuccessful with the smaller tank size, it was then modeled with a larger 50-kg tank size (right bar, Extended Range). Currently, 35-ft FCEBs are only equipped with 35-kg hydrogen tanks, while 50-kg tanks can only be outfitted on 40-ft FCEBs (or larger).

The majority (96%) of BFT's fixed-route blocks and vehicle assignments can be successfully transitioned to hydrogen FCEBs when using extended range FCEBs equipped with 50-kg hydrogen tanks; all 35-ft assignments were successful in the model. For Route 170 (weekday block 170-1), the only unsuccessful block, re-blocking would need to be considered to accommodate midday refueling or a vehicle change-out.

Figure 15: Successful blocks and vehicle assignments that can be served by FCEB equivalents (fixed routes)

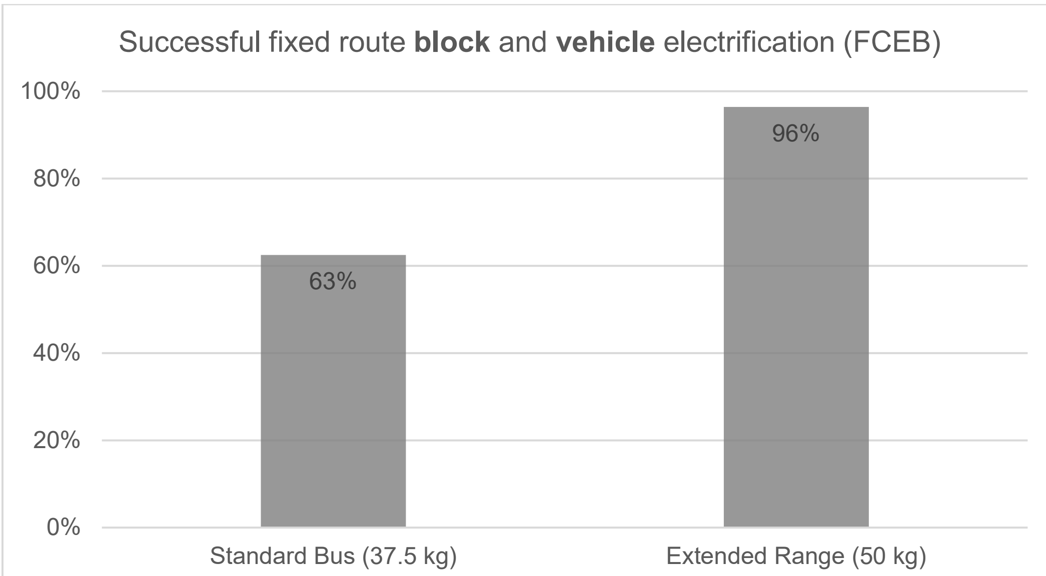


Table 7 provides the average fuel efficiency for each vehicle type modeled.

Table 7: Average fuel efficiency for fixed route FCEB modeling results

Vehicle type	Average fuel efficiency (mi/kg)
40-ft bus	7.42 mi/kg
35-ft bus	8.62 mi/kg
Overall	7.55 mi/kg

4.2 FLEET CONCEPTS

For service modeled with standard 525 kWh batteries, only a small portion of vehicles (16%) can be successfully electrified. All blocks that use 30-ft buses were unsuccessful and no option for larger batteries currently exists. By modeling blocks operating with 40-ft buses with larger battery sizes, the success rate increased to 49%.

On-route charging provides a workable solution for blocks that were not successfully modeled with in-depot-only charging. Three BFT-owned transit centers were identified where on-route charging could occur: KCT in Richland, 22TC in Pasco, and the TRTC in Kennewick. To meet power requirements for fast charging at KTC and 22TC, two on-route chargers would need to be installed; one 350 kW unit to actively recharge vehicles throughout the day and one spare for redundancy in case of equipment failures. TRTC would require at least two fast-charging units as layover times overlap more often. For redundancy, only one additional unit is recommended since only 14% of charging events occur simultaneously.

For service modeled with FCEBs, the majority (96%) of BFT's fixed-route blocks and vehicle assignments can be successfully transitioned to hydrogen FCEBs when using extended range FCEBs equipped with 50-kg hydrogen tanks. This assumes that all routes except for 110 and 123 would be replaced with 40-ft. FCEBs. Additionally, one block (170-1) would need to be considered for re-blocking.

Following the modeling results, a variety of potential solutions were developed for each service type to weigh the pros and cons of different solutions across different areas of interest, including financial, facility, and operational considerations. Following the development of the preliminary solutions, Stantec met with BFT staff to workshop the feasibility of the different solutions and come to a preferred fleet concept that best fits the needs of BFT. Two fleet concepts are presented below.

Fleet Concept A

Fleet Concept A is a BE-based fleet relying on both in-depot charging to recharge buses overnight to be ready for each day of service, while also strategically leveraging on-route chargers at BFT's transit centers to enable BEB operations (Table 8).

Table 8: Fleet Concept A – BEB Fleet with On-Route and In-Depot Charging

Vehicle type	Battery size(s)	Quantity of Active Buses	Notes
35-ft. buses	450 kWh	6	Fast on-route charging would be required for routes operated by 35-ft BEBs. These 35-ft BEBs would replace BFT's 30-ft fossil fuel buses on routes 110 and 123.
40-ft buses	660 kWh	49	Fast on-route charging was identified as a solution for 22 40-ft buses that require additional range. One block (170-1) will need to be reblocked. This fleet concept also assumes that 29-ft, 30-ft, and 35-ft (except for buses operating on routes 110 and 123) will be replaced with 40-ft BEBs.

Fleet Concept B

Fleet Concept B is an FCE-based fleet, as described in Table 9. This concept requires two different FCEB models (35-ft. and 40 ft.). This fleet option also entails the use of 35-ft buses instead as no 30-ft FCEBs currently exist on the market.

Table 9: Fleet Concept B - FCE Fleet

Vehicle type	Tank size	Quantity of Active Buses	Notes
35-ft. buses	35 kg	6	All blocks and vehicle assignments are successful under the modeling conditions. Only 35-ft. FCEBs are currently available, and these 35-ft FCEBs would replace BFT's 30-ft fossil fuel buses on routes 110 and 123.
40-ft buses	50 kg	49	One block (170-1) would still need to be reblocked. This fleet concept also assumes that 29-ft, 30-ft, and 35-ft (except for buses operating on routes 110 and 123) will be replaced with 40-ft BEBs.

4.3 CONCLUSION AND PREFERRED FLEET ALTERNATIVE

Based on the fleet modeling and initial cost considerations, as well as implications for operations, Stantec and BFT staff discussed the merits of each fleet concept to develop a preferred fleet alternative. From a preliminary high-level consideration of costs, we estimated that a fleet of BEBs or a fleet of FCEBs would be roughly the same in capital costs. This is because of BFT's fleet size and the costs of either BEB chargers or a hydrogen fueling station being somewhat comparable for the needs of BFT's fleet size and operations.

One crucial non-quantitative consideration influencing the technology decision is the availability and supply chain of the two ZEB fuels—hydrogen and electricity. Currently, the hydrogen supply chain is in development in the Pacific Northwest and currently lacks any public fueling. BFT has an active commitment to begin transitioning to ZEBs as soon as possible. To begin transitioning to a ZEB fleet, a deployment of BEBs would meet BFT's climate goals likely sooner than an FCEB fleet. **Nonetheless, this does not preclude BFT from exploring and potentially deploying FCEBs sometime in the future.**

Based on these considerations, the full rollout plan framework developed here proposes 100% BEB by 2040. However, we also describe a more constrained approach to transition 25% of the fleet to alternative fuel ZEBs.

4.4 POWER DEMAND MODELING AND CHARGING PROFILE

In-Depot Charging Profile

After determining the preferred and recommended fleet composition for BFT, the subsequent step is to estimate the power capacity at the transit facility to meet the energy demand for an all-BEB fleet to identify the required utility upgrades. Several operational factors were incorporated as parameters for the power modeling, including:

- Charging/recharging time window: Stantec assumed all buses start charging overnight and can charge during the day between blocks, i.e., charging can occur during out-of-service times. This input is the service schedule of vehicle pull-out and pull-in times for a representative day and according to the blocking and scheduling changes made during fleet composition refinement.
- 150 kW in-depot chargers for 40-ft and 35-ft buses (Charger Output in Equation 1)
- A 90% charger efficiency (Eff. in Equation 1)
- A 25% contingency factor to account for the limits of onboard charging equipment that limit the maximum power capacity from the chargers (Contingency in Equation 1)
- Assuming negligible time between when a bus enters the facility and is connected to charger and starts charging

Other assumptions specific to the charging profile of the BEBs include:

- Since the modeling revealed that only a portion of the fixed-routes vehicles (~50%) can complete their daily service with currently available battery sizes (450 kWh for 35-ft buses and 675 kWh for 40-ft BEBs), to estimate the power requirements for a 100% successful service, we assumed that all non-successful blocks will have on-route charging at the transit centers (Section 4.1) and will only charge at the yard up to 80% of their battery capacity
- Service period for all blocks was based on the dispatch data provided by BFT for a representative day

Using the technical specifications and assumptions from the charging equipment, the charging hours (hours of charging required per block) that are required based on the daily energy demand were calculated using Equation 1 for each vehicle.

Equation 1: Hours of charging needed to serve daily energy demand

$$Hrs.Charging = \left[\left(\frac{kWh}{day} * \frac{1}{Charger\ Output\ kW}\right) * \frac{1}{eff.}\right] * (1 + Contingency)$$

Equation 1 was applied to the daily energy demand calculated for all blocks and vehicle assignments. The total charge time per block per vehicle was then used to develop a vehicle charging schedule for

BFT's division (i.e., hours during the day that each bus needs to charge in order to have enough energy to go into service at the time specified by the service or dispatching schedule).

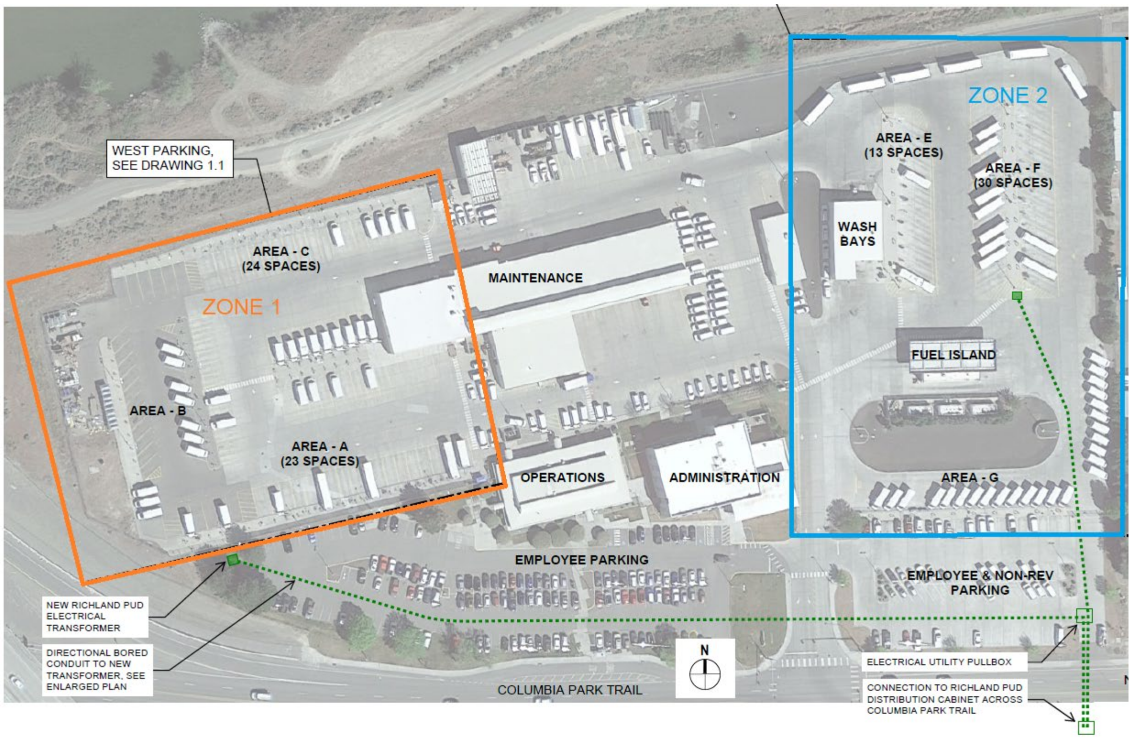
The number of hours each charger needs to be online provides the power requirement, and the cumulative number of connected chargers at a specific hour represents the total power required at each hour of the day. For example, if 10 chargers with a maximum capacity of 150 kW are connected at the same time for one hour, the power demand during this hour is 1,500 kW.

Two main charging zones, Zone 1 in orange and Zone 2 in blue shown in Figure 16, were designated since a different feeder from the utilities will be required. Withing each zone, different areas were also created to set a phasing strategy within the yard. Each zone will have its own charging profile and that will dictate the total power.

The key aspect of calculating the power demand for each hour of the day is assigning the correct charging schedule to every bus serving a specific block. Assigning charging times to the vehicles was based on the following parameters:

- Charging buses as soon as they return to the base
- Charging during vehicle not-in-service hours based on block schedules
- Smart charging software will be implemented to optimize the charging times and guarantee all vehicles will be charged and ready for service
- No demand chargers or different rates for time of use (TOU) are currently in place by City of Richland PUD. Therefore, no restrictions were set in place to avoid charging during certain hours of the date. Nevertheless, the charging profile aimed to minimize high, isolated power peaks since that would imply a higher infrastructure capital investment for oversized equipment.
- City of Richland PUD has the following charges for a Schedule 24 Rate:
    - $2.01/Day
    - 4.28¢ per KWh
    - Monthly Demand Charge: $5.58 per KW

Figure 16: Charging Zones for BFT's Main Facility



The power modeling provides the following outputs:

- The maximum number of chargers that need to be connected at each hour of the day
- Representative daily charging schedule for each zone
- Maximum power requirements for each zone

Figure 17 displays the charging schedule and daily power requirements at BFT's bus yard, Zone 1, while Figure 18 shows the charging schedule for Zone 2.

Figure 17: BFT charging profile and power requirements for Zone 1

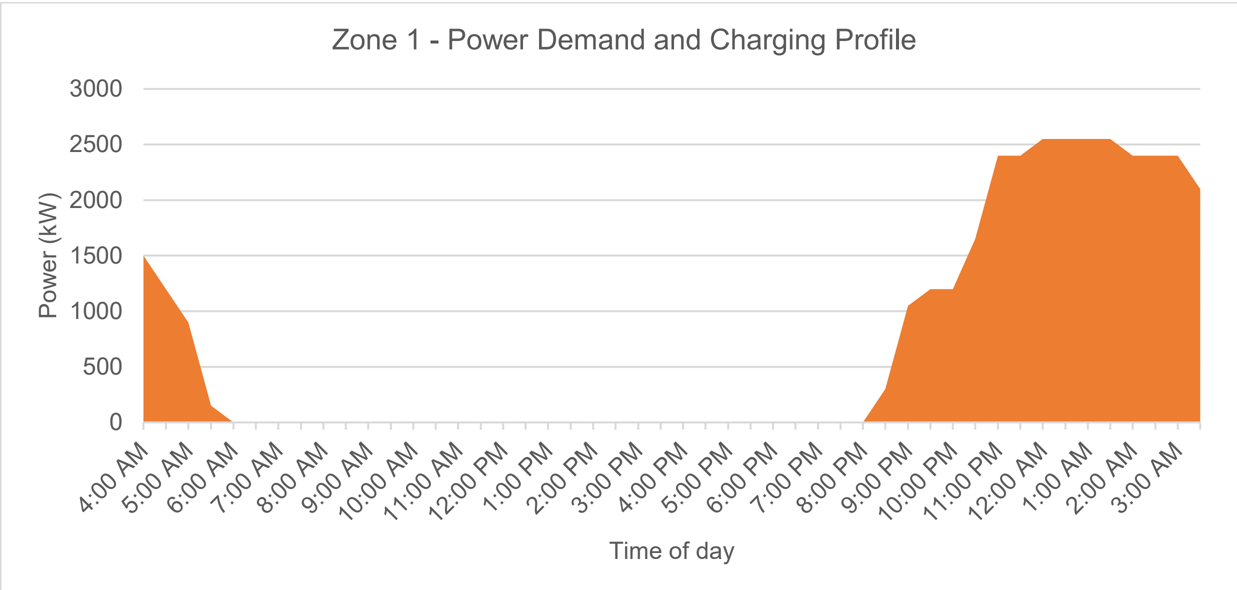


Figure 18: BFT charging profile and power requirements for Zone 2

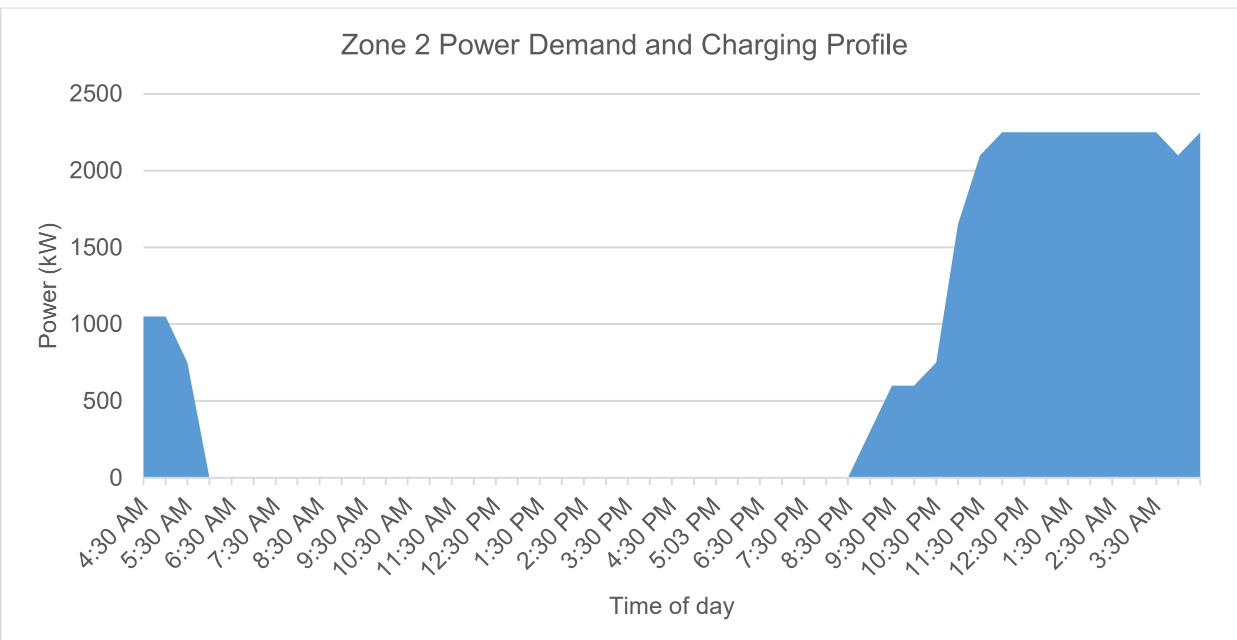


Table 10 shows total daily energy requirements and maximum power required. A 10% contingency was added to the calculated power capacity to account for additional chargers coming online or for any failures in the smart charging system.

The charging profile and total number of online chargers will vary if using smart charging management software, but the analysis shown here ensures that a high demand service day for BFT can be achieved under a minimum power demand of 2.55 MW for Zone 1 and 2.25 MW for Zone 2. Nevertheless, given requirements by local utilities, and as a good practice to protect the electrical equipment, the installed power capacity at each zone should be equal to the total capacity of the installed charging equipment. Meaning, if Zone 1 has 20 charging units, each with 150 kW, then the total installed capacity should be 3,000 kWh (20 x 150kW = 3,000 kWh) or 3 MW, even if at any given point the smart charging software is able to keep the power demand below 2.55 MW. Similarly, the installed capacity for Zone 2 should also be 3,000 kWh or 3 MW.

Table 10: Summary of maximum power demand and total energy requirements

Name, Location	Existing Charger	No. of 150 Charging Units	No. of Dispensers	Min Power Demand (MW)	Installed Capacity (MW)
Zone 1 (Area A and C)	N/A	20	40	2.55 MW	3 MW
Zone 2 (Area E and F)	1	20	41	2.25 MW	3 MW

On-Route Charging Profile

A similar methodology to the depot-charging modeling was used to estimate the power capacity at the transit centers. Several operational factors were incorporated as parameters for the power modeling, including:

- Charging/recharging time window: Only layover times were considered for the charging of BEBs. Additionally, charging events were designed to occur with as minimal simultaneous charging events as possible. Meaning, to only charge the fewest number of BEBs at the time to limit the power peaks
- 350 kW on-route fast chargers at each transit center
- A 90% charger efficiency
- Assuming 2 minutes time between when a bus enters the center and is connected to charger to start charging

As described in Section 4.1, under the subsection called BEB On-Route Modeling Results, the results for each transit center provide both the time of day buses would utilize an on-route charger and the minimum power requirements at the transit center. Figure 19 shows the minimum power demand at KTC, Figure 20 shows the expected minimum power requirements at 22TC, and Figure 21 shows how TRTC has a higher maximum required power than the other two transit centers.

Figure 19: Power requirements for on-route charging at Knight Street Transit Center

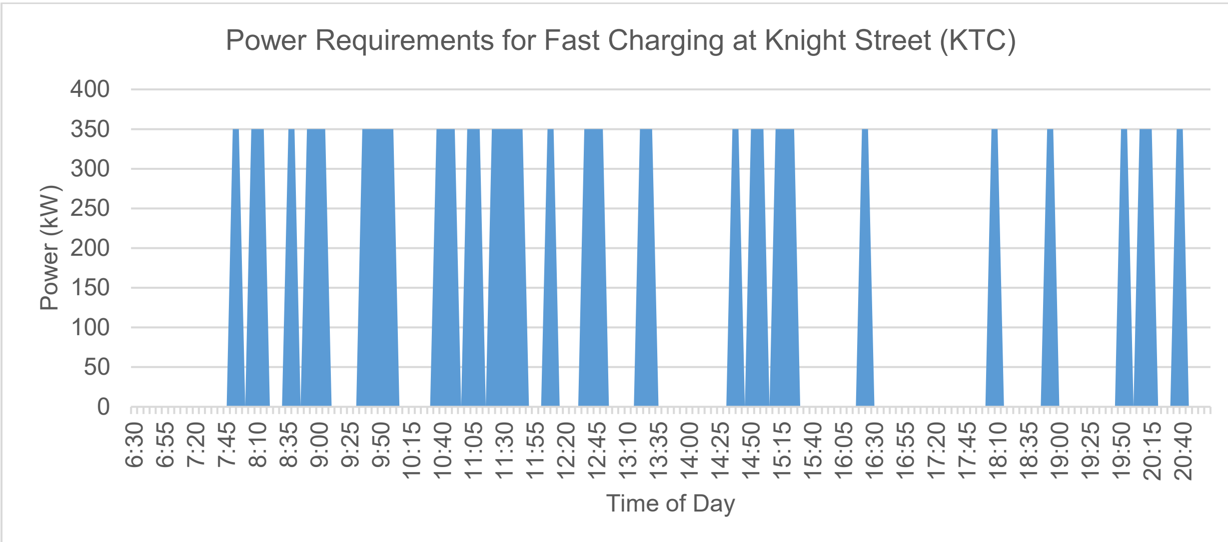


Figure 20: Power requirements for on-route charging at 22nd Street Transit Center

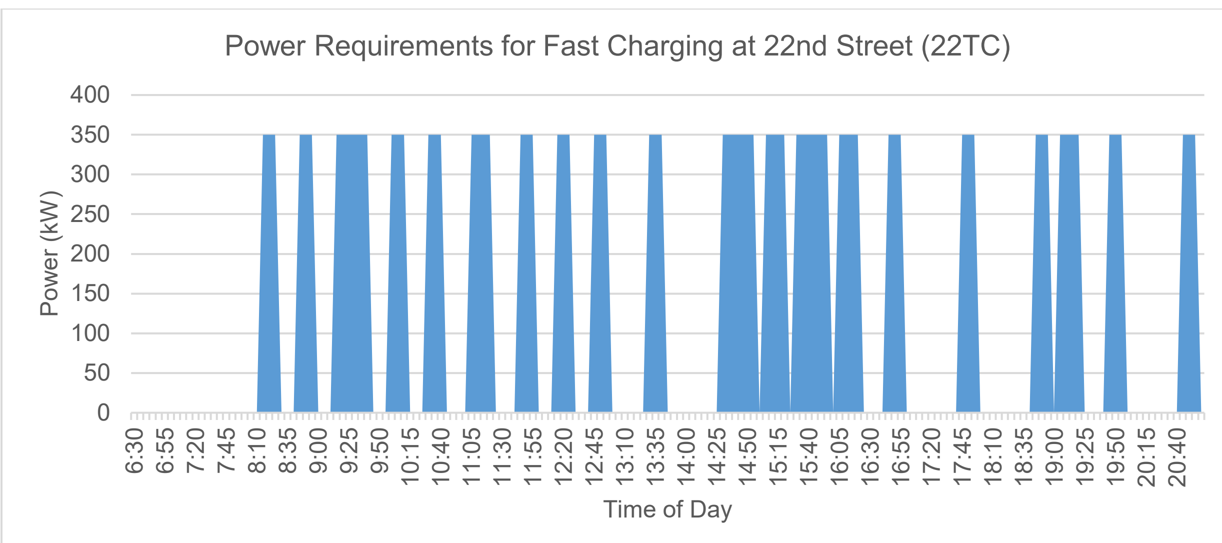


Figure 21: Power requirements for on-route charging at Three Rivers Transit Center

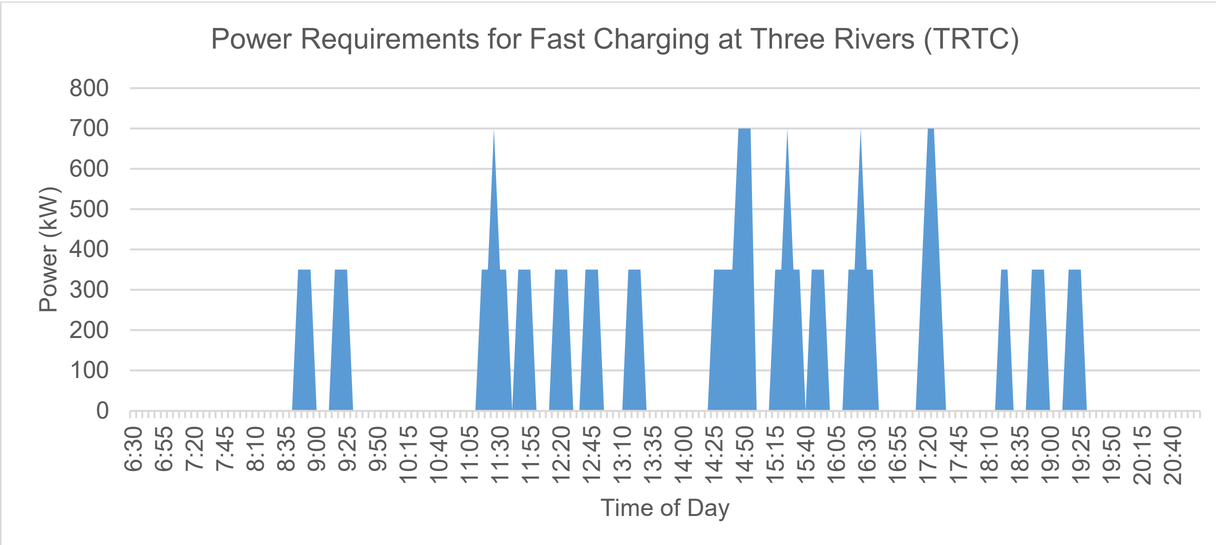


Table 11 presents a summary of the charging equipment requirements at each transit center, as well as the minimum power demand that is expected and the recommended installed capacity that is based on the capacity of the installed equipment. Two fast charging units, each at 350 kW, are recommended for KTC and 22TC and three charging units are recommended for TRTC.

Table 11: Summary of power demand for on-route charging at Transit Centers

No.	Abbreviation	Name, Location	No. of Fast Charging Units	Charger Capacity (kW)	Min Power Demand (kW)	Installed Capacity (kW)
TC1	KTC	Knight Street TC, Richland	2	350	350	700
TC2	22TC	22nd Ave TC, Pasco	2	350	350	700
TC3	TRTC	Three Rivers TC, Kennewick	3	350	700	1050

5.0 FLEET AND INFRASTRUCTURE PHASING STRATEGY

This section presents the proposed fleet phasing plan that will gradually phase out the oldest diesel buses in BFT's fleet and replace them with BEBs. Importantly, the proposed fleet plan also eliminates 30-ft buses from the fleet, as 30-ft BEBs with on-route charging capabilities are not currently available by manufacturers.

As such, the fixed-route fleet would be composed mainly of 40-ft BEBs with a smaller proportion of 35-ft BEBs. This section also outlines the charging equipment requirements at BFT's depot, and at the three transit centers, as well as their phasing to align with BEB procurement. Ideally, chargers and their supporting equipment should be installed and functional at least six months prior to acquiring the complementary BEBs.

5.1 FLEET PLAN

Table 12 outlines the procurement strategy to phase out diesel buses. With BEBs arriving as early as 2023/24, BFT's fleet could be 100% electric by 2037. BFT has one BEB bus in their fleet, but it is currently not operating the vehicle since it needs to be replaced with an updated generation. Specific to the transition to larger vehicles, in 2025 the first five 30-ft buses could be retired and replaced with five 35-ft BEBs, the next retirement for 30-ft diesel buses occurs in 2036 to be replaced with six 35-ft BEBs.

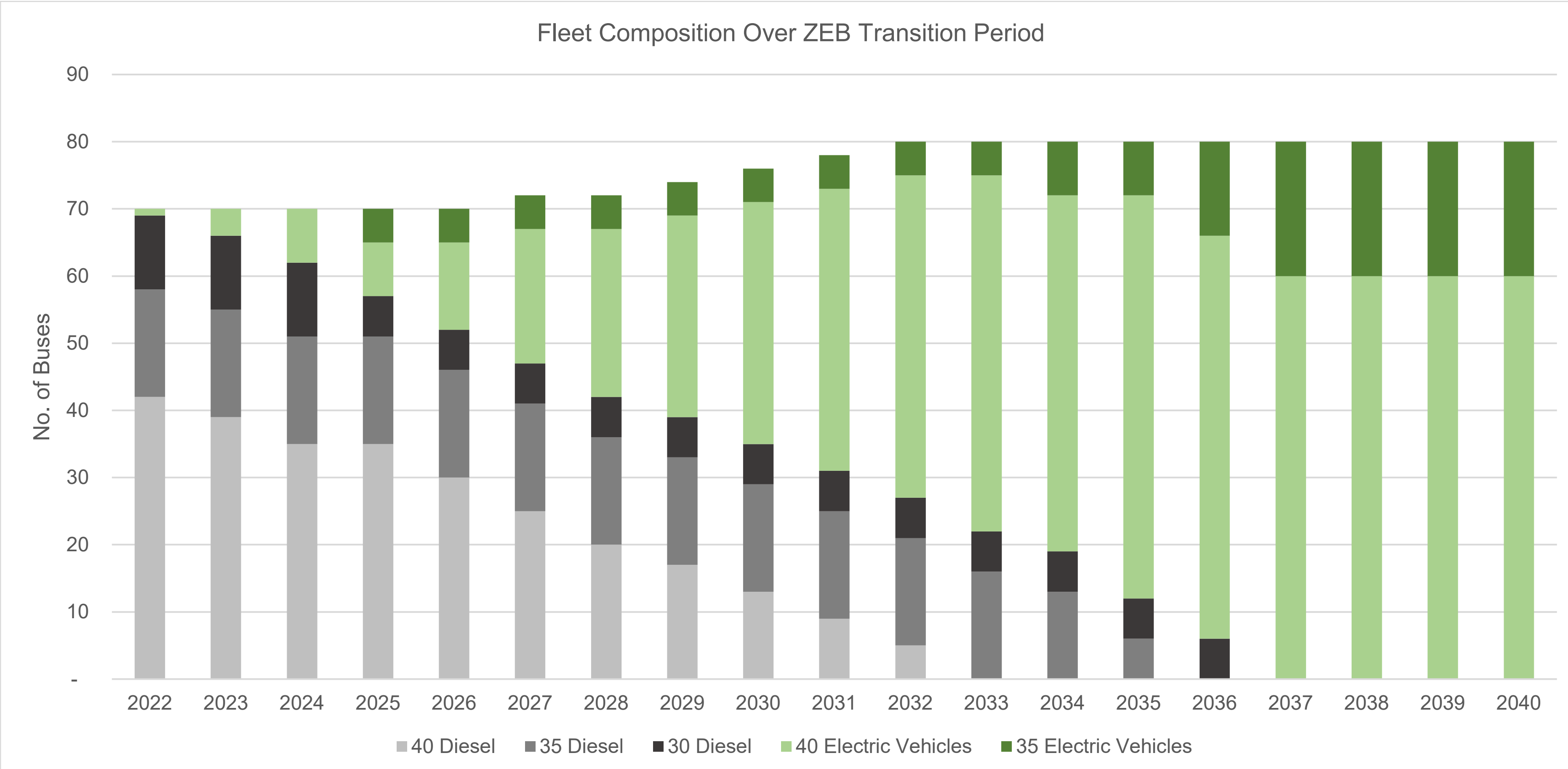
The retirement of diesel buses was based on the useful life of the vehicles to avoid early retirement. The inventory details for all assets of the fleet were provided to Stantec by BFT. Furthermore, the fleet plan considers increasing the fleet from 70 buses to 80, a total addition of 10 vehicles in anticipation of service expansion over time. The first two extra vehicles could arrive in 2027 with two more added each year from 2029 to 2032.

Figure 22 shows how the fleet transitions from fossil-based fuels to battery electric vehicles, starting with the current singular BEB in BFT's fleet, to reach a 100% electric fleet by 2037.

Table 12: Conceptual Vehicle Procurement Plan

	Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
40-ft	Diesel	42	39	35	35	30	25	20	17	13	9	5	-	-	-	-	-	-	-	-
	Cumulative BEBs	1	4	8	8	13	20	25	30	36	42	48	53	53	60	60	60	60	60	60
	Purchased BEBs	-	4	4	-	5	7	5	5	6	6	6	5	-	7	-	4	4	-	5
35-ft	Diesel	16	16	16	16	16	16	16	16	16	16	16	16	13	6	-	-	-	-	-
	Cumulative BEBs	-	-	-	5	5	5	5	5	5	5	5	5	8	8	14	20	20	20	20
	Purchased BEBs	-	-	-	5	-	-	-	-	-	-	-	-	3	-	6	6	-	5	-
30-ft	Diesel	11	11	11	6	6	6	6	6	6	6	6	6	6	6	6	-	-	-	-
	Cumulative BEBs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Purchased BEBs	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Totals	**Total Diesel**	**69**	**66**	**62**	**57**	**52**	**47**	**42**	**39**	**35**	**31**	**27**	**22**	**19**	**12**	**6**	**-**	**-**	**-**	**-**
	Total ZE	**1**	**4**	**8**	**13**	**18**	**25**	**30**	**35**	**41**	**47**	**53**	**58**	**61**	**68**	**74**	**80**	**80**	**80**	**80**
	Total	**70**	**70**	**70**	**70**	**70**	**72**	**72**	**74**	**76**	**78**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**	**80**
	Total ZE %	**1%**	**6%**	**11%**	**19%**	**26%**	**35%**	**42%**	**47%**	**54%**	**60%**	**66%**	**73%**	**76%**	**85%**	**93%**	**100%**	**100%**	**100%**	**100%**

Figure 22: Conceptual BFT Fleet Composition, 2022-2040



5.2 PHASING OF CHARGING EQUIPMENT

Given the established phasing strategy of vehicles into BFT's facility, the charging equipment should be set in place prior to the arrival of each BEB procurement. While in Section 4.40 the total number of active charging modules and plug-in dispensers were modeled to minimize the power requirements at the facility, the final recommendation of equipment was based on having one plug-in connection for each vehicle. Table 13 provides a summary of the total number of ZE vehicles at BFT's maintenance facility at key years of acquisition.

Table 13: Conceptual Summary of Fleet Phasing Strategy

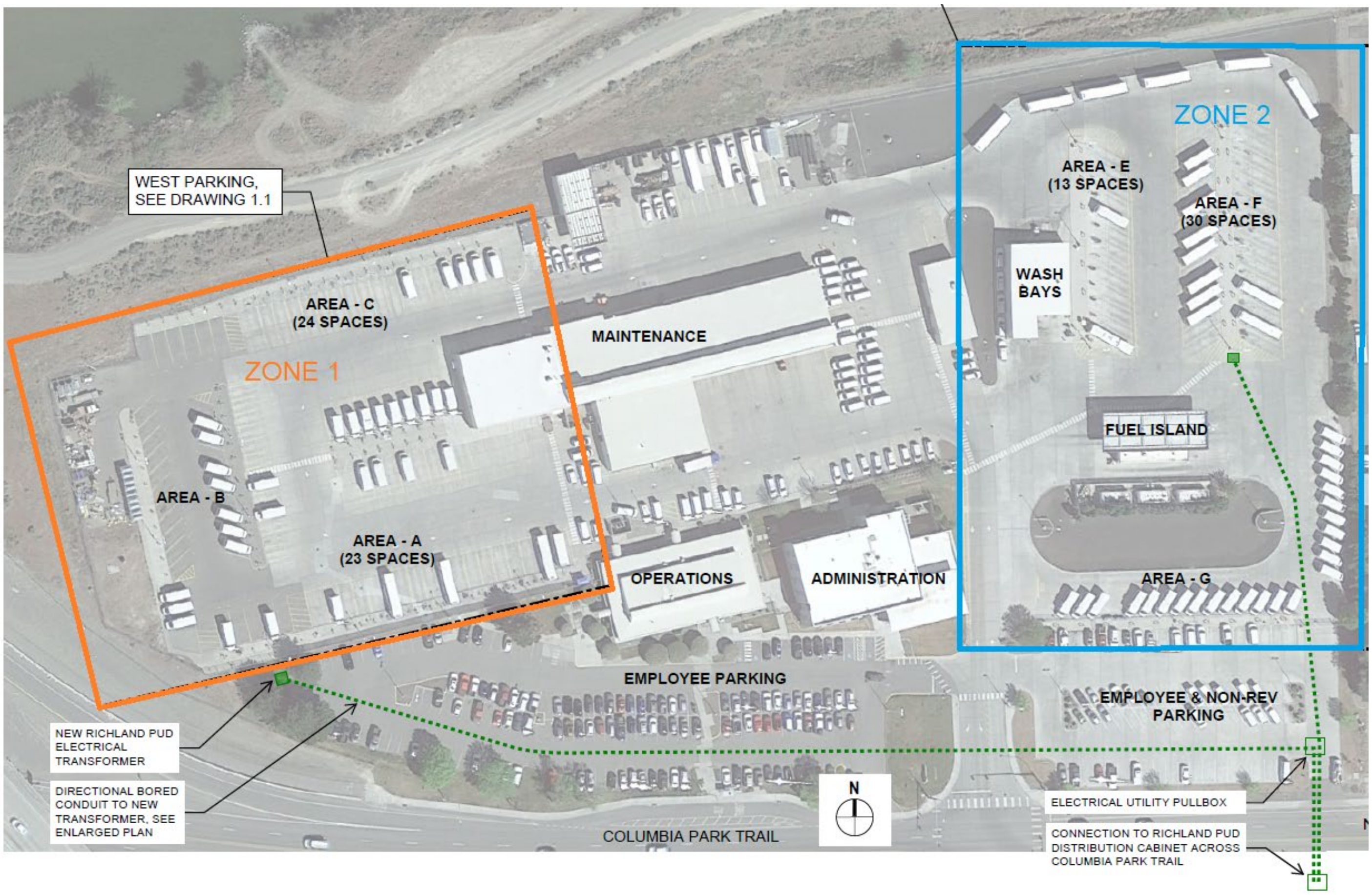
	2023	2024		2027	2028	2029	2030	2031	2032	2033	2034		2040
Chargers Installation		10		0	10	0	0	0	6		14		0
Cumulative chargers	1	11		11	21	21	21	21	27	27	40		40
Plug-in Installation		20	…		20				12	0	28	…	
Cumulative plugs	1	21		21	41	41	41	41	53	53	80		80
Cumulative Buses on-site	**4**	**8**		**25**	**30**	**35**	**41**	**47**	**53**	**58**	**61**		**80**

The recommended charging equipment was based on the following features:

- Each bus will have a plug-in dispenser connection available
- Charging cabinets with 150 kW capacity
- 1:2 for the charger to dispenser ratio (i.e., two plug-in dispensers will be connected to each charging cabinet)

Figure 23 presents the schematic of the recommended phasing of BEB deployment at BFT's maintenance facility. In this schematic, Zone 1 would be constructed first to install transformers and all related underground connections, while Zone 2 would be constructed subsequently. Additionally, each zone has designated areas that will also have different phasing strategies for the charging equipment which will require minor disruptions to yard given that all underground connections will be already in place.

Figure 23: Parking area diagram phasing



The supporting infrastructure equipment will need to be in place prior to the vehicles arriving. Therefore, based on the ZEB vehicle count, and while minimizing operational disruptions due to construction, the equipment phasing strategy was designed as described in Table 14. This phasing strategy was divided in four phases and includes the modifications to the transit centers.

Table 15 describes what activities will be conducted under each phase.

Table 14: Conceptual Charger equipment requirements per year

	23/24	27/28	29/30	31/32	33/34
	Phase I	Phase II	Phase III	Phase IV	
Zone to be Modified	Zone 1	Zone 1		Zone 2	Zone 2
Area to be Modified	A	C		E	F
Transit Center Modifications		22TC	TRTC	KTC	

Table 15: Description of each Phase for the Equipment Implementation

	Description
Phase I	First Transformer and generator installation, conduit layout for Area A, charger installation in Area A
Phase II	Conduit in Area C, charger installation in Area C. Grid connection and fast Charging installation at 22TC
Phase III	Grid connection and fast charging installation at TRTC
Phase IV	Second Transformer and generator installation, conduit layout for Area E and F, charger installation in Area E
	Charger installation in Area F, 7 chargers and 14 dispensers in 2033 and 7 chargers and 14 dispensers in 2035. Grid connection and fast charging installation at KTC

Details on the charging infrastructure for the transit centers is found in Table 16.

Table 16: Details on Charging Infrastructure for each Transit Center

No.	Abbreviation	Name, Location	No. of Fast Charging Units	Installed Power (kW)	Installation Phase	Proposed Installation Year
TC1	KTC	Knight Street Transit Center, Richland	2	700	Phase IV	2031/2032
TC2	22TC	22nd Ave Transit Center, Pasco	2	700	Phase II	2027/2028
TC3	TRTC	Three Rivers Transit Center, Kennewick	3	1050	Phase III	2029/2030

5.3 25% ZEB FLEET STRATEGY

The approach that BFT will take based on current information and grant availability is to deploy 2 new BEBs in 2024. Stantec and BFT have worked together to understand the power needs and based on discussions with the local utilities, BFT has sufficient power at its yard to support two BEB chargers without significant upgrades required to the electrical systems. Section 6.0 provides more detailed information about subsequent steps with the utility, as well as what 100% BEB fleet could look like.

Beyond the two BEBs, BFT is planning to transition 25% of its diesel fleet to ZEBs by 2040, either BEB or/and FCEB—this equates to approximately 18-20 ZEBs by 2040. To a large degree, the goal of 25% ZEBs by 2040 will strongly depend on funding, and BFT is actively assessing the dates and milestones for transition.

6.0 MAINTENANCE FACILITY INFRASTRUCTURE MODIFICATIONS

This section outlines the proposed facility modifications for BEB implementation to BFT's bus operations and maintenance facility. The master plan option has been developed proposing ground-mounted charging dispensers. The facility has sufficient space opportunity for ground-mounted dispensers, avoiding the reduction in parking stalls while keeping yard flexibility since a considerable amount of physical infrastructure can be placed on the existing curbs and islands in the bus parking areas.

The existing service cycle can be maintained and is not required to be changed for BEB implementation. Since the liquid fueling system used by BFT will need to be maintained onsite for the vehicles not being considered for electrification, the above-ground fuel tanks and associated dispensers will need to remain.

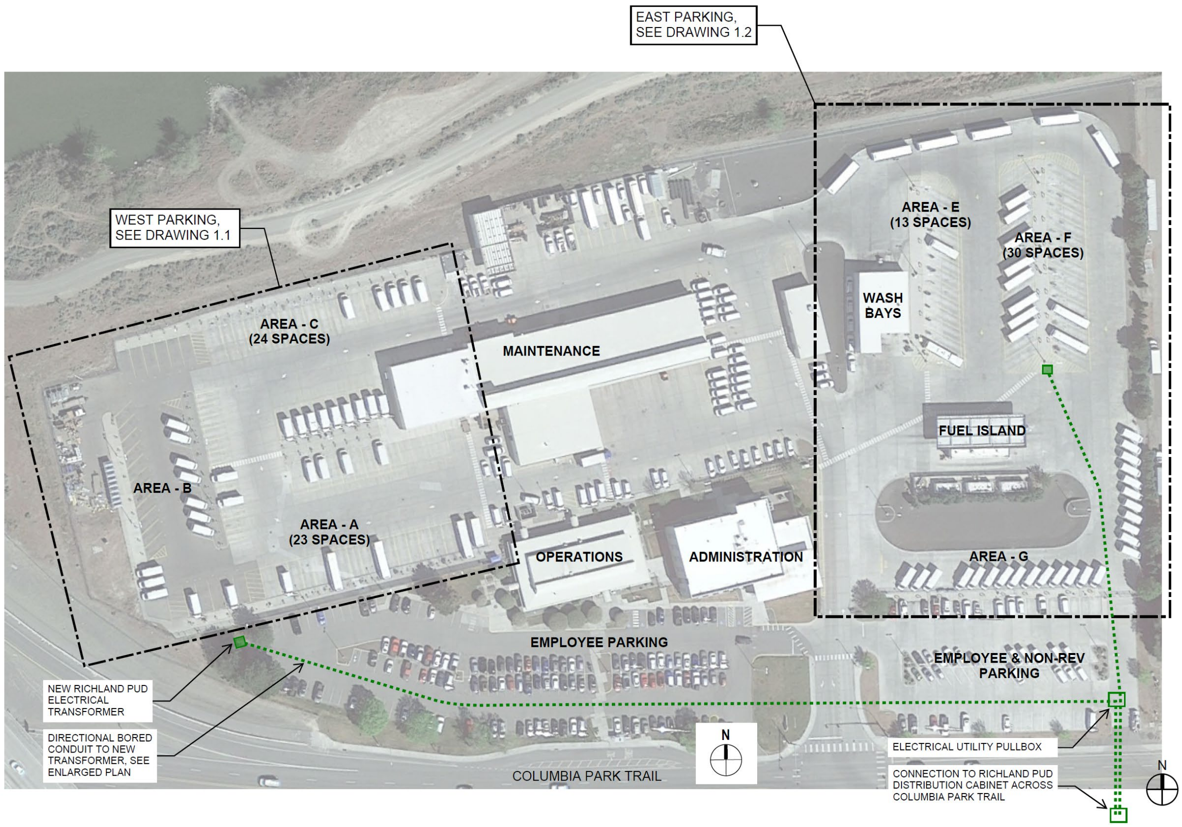
6.1 CURRENT SITE ELECTRICAL CONSIDERATIONS

Connecting a BEB charger to an existing panelboard will require a 30-day load metering to determine the peak load on that panel and its remaining capacity. The Operations facility has multiple services including 2 225 KVA transformers and 1 500 KVA transformer. It is unlikely that either 225 KVA transformer could support more than a single 150 kW charger and the 500 KVA service capable of supporting more than two BEB chargers simultaneously. Prior to installing a charger on any of the existing services it is recommended that BFT contact the City of Richland and the PUD and notify them of the additional loading.

6.2 PROPOSED MAINTENANCE FACILITY MODIFICATIONS

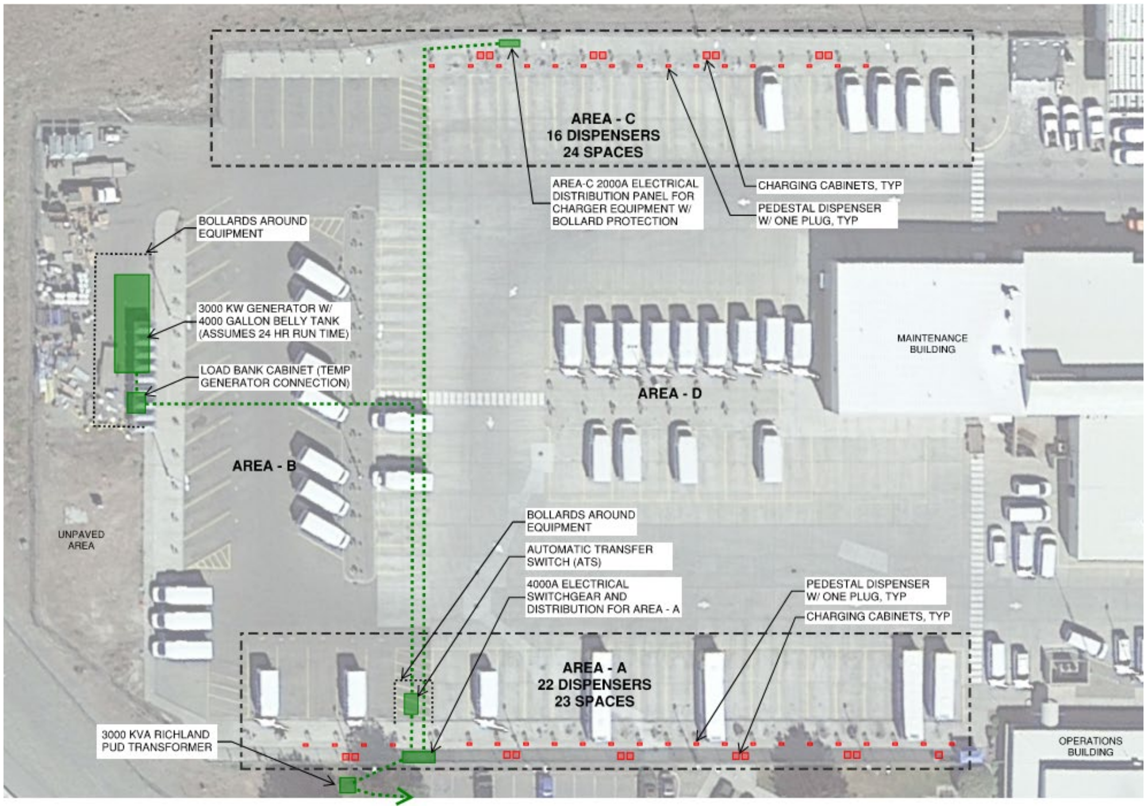
The following summarizes the proposed improvements for the ground-mounted dispensers in the event that BFT transitions to 100% BEB; if BFT decides to pursue alternatives to BEBs, the site planning below still provides useful guidance for potential phasing and organization of charging infrastructure (Figure 24). More detailed electrical analysis may be required to right-size the equipment based on BFT's actual ZEB deployment.

Figure 24: BFT ZEB Site Conceptual Master Plan



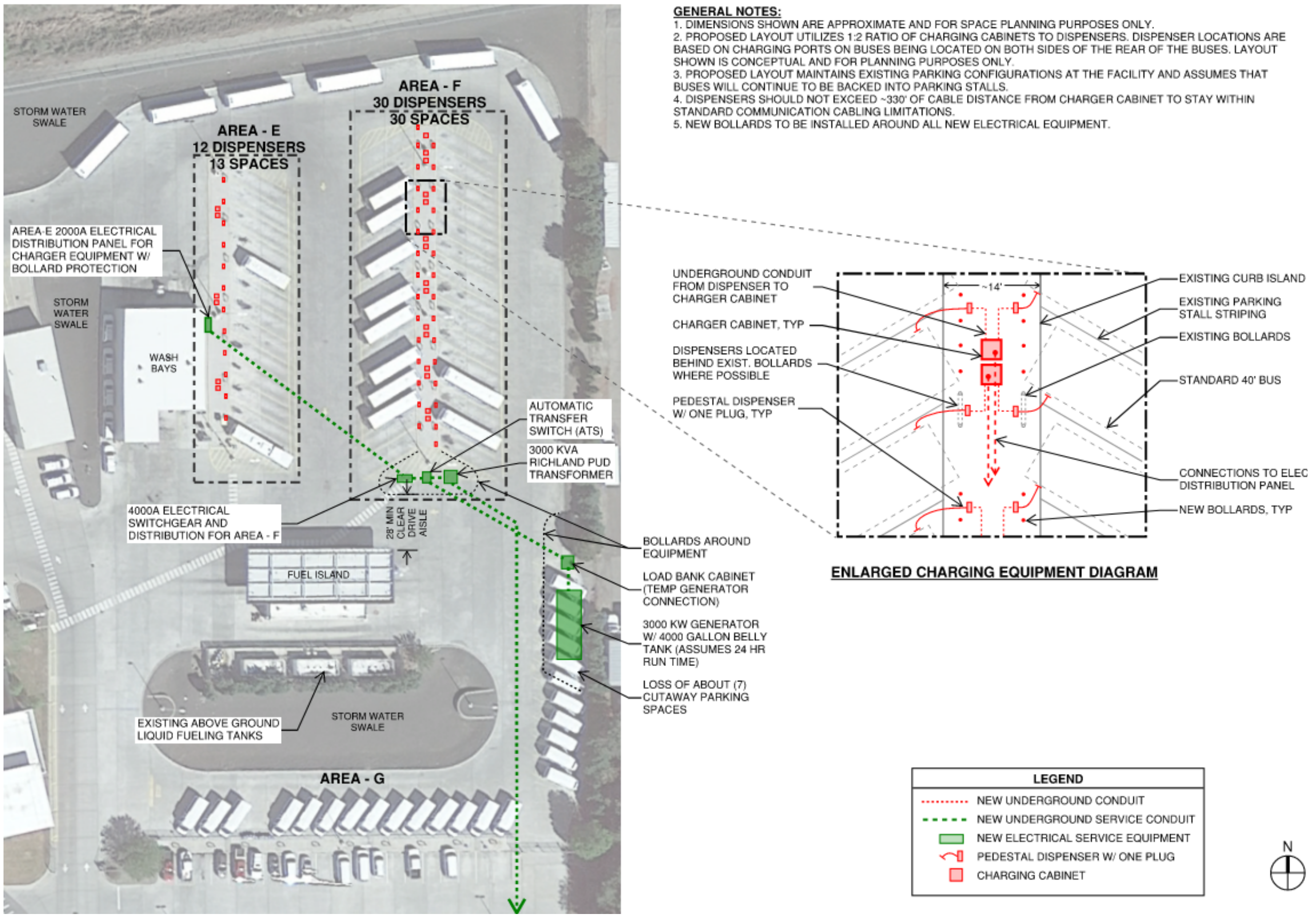
- Parking Areas A & C in the west area, see Figure 25:
  - A new 3,000 kVA transformer and 4,000 A switchboard to provide adequate additional power to the facility, along with associated equipment pads and bollards.
  - A new 3,000 kW generator with 4,000 gallons of onsite diesel fuel storage in order to support 100% bus service for one day; the current calculation assumes fuel needed for one day of outage.
  - New ATS (automatic transfer switch) between generator and switchgear.
  - A minimum of 19 150-kW vehicle chargers with a 1:2 charger-to-dispenser ratio (SAE J1772-compliant) to serve a maximum of 38 active (in revenue service) 40-ft and 35-ft buses.
    - Equipment pads and associated bollard protection around chargers and dispensers
    - Power main feeder and sub feeders
    - Communication system panel/distribution cabinet and conduits to each charger
    - All service conduit connecting the power cabinets to the dispensers assumed to be underground and will occur within the existing curb islands.
  - Pavement replacement/repair for trenching associated with electrical distribution for locations where new electrical service and switchboard will be allocated.
  - No proposed modifications to the buildings.

Figure 25: BFT ZEB Site Conceptual Master Plan – West Parking Areas



- Parking Areas E & F in the East area, see Figure 26
  - A new 3,000 kVA transformer and 4,000 A switchboard to provide adequate additional power to the facility, along with associated equipment pads and bollards.
  - A new 3,000 kW generator with 4,000 gallons of onsite diesel fuel storage; the current calculation assumes fuel needed for one day of outage.
  - New ATS (automatic transfer switch) between generator and switchgear.
  - A minimum of 21 150-kW vehicle chargers with a 1:2 charger-to-dispenser ratio (SAE J1772-compliant) to serve a maximum of 42 active (in revenue service) 40-ft and 35-ft buses.
    - Equipment pads and associated bollard protection around chargers and dispensers
    - Power main feeder and sub feeders
    - Communication system panel/distribution cabinet and conduits to each charger
    - All service conduit connecting the power cabinets to the dispensers assumed to be underground and will occur within the existing curb islands.
  - Pavement replacement/repair for trenching associated with electrical distribution for locations where new electrical service and switchboard will be allocated.
  - New pavement markings and striping at removal of portion of cutaway vehicle parking.
  - No proposed modifications to the buildings.

Figure 26: BFT ZEB Site Conceptual Master Plan – East Parking Areas



6.3 GRID CONNECTION UPGRADES

The facility will require new electrical service connections from Richmond PUD. The utility will likely require that a service study be performed to identify any transmission or distribution system upgrades that may be needed to support the additional power demands. It will be up to the utility to determine if the local power distribution system has the capacity to serve BFT's new charging loads as well as any other planned loads in the area. The recommendations here are focused on those infrastructure upgrades that are to be located on the agency's property and do not include any system upgrades that the service study may identify. The extent and timing of the system upgrades will determine the net cost to the agency. Nevertheless, there is a possibility that the current installed transformer can support a small portion of BEB fleet without major upgrades. To evaluate this, BFT would need to coordinate with BFT and conduct a load assessment for the current transformer to determine how many chargers can be connected as an interim step to deploy BEBs prior to completing major grid connection upgrades.

6.4 COMMUNICATION INFRASTRUCTURE

Infrastructure for data communications within the charging system will include IP Ethernet wiring between each charger and its associated dispensers, as well as between each charger and a local data switch. The actual wiring will be conventional Cat 6 Ethernet cable between devices or fiber, which would require a telecom cabinet. As the maximum length allowed for Ethernet is 100 meters or 328 ft., the dispensers cannot be too far from their respective charger. Although longer distances are possible with fiberoptic cable, the DC power cables that need to run parallel with the Ethernet cables begin to have problems with voltage drop at this distance, so 328 ft. is a recommended limit.

Once the Ethernet lines from each charger are routed back to the facility's data switch, the data can be contained within BFT's local network and managed directly by the agency. Alternately, the data can be routed to a cloud-based system – as needed to provide smart-charging and data aggregation—that is managed by a third party and/or is provided by the charger manufacturer. However, this would likely require coordination and approval of security and access, as it would necessitate outside entities operating within BFT's local network. Additionally, is recommended for BFT to implement a wi-fi network in the yard for smart charging communication to buses while any other communication upgrade is occurring or as an alternative to traditional communications systems.

6.5 FIRE PROTECTION CONSIDERATIONS

With the implementation of BEBs, fire protection and life-safety concerns can be significant. However, due to the relatively new advent of these associated technologies, building and fire protection codes have not specifically addressed most of these concerns. National Fire Protection Association (NFPA) 855 'Standard for the Installation of Stationary Energy Storage Systems' is a standard that can potentially be applied to BEB storage, but this particular standard is excessive relative to the capacity of the batteries onboard buses and considering all of BFT's buses are stored outside. The need for enhanced fire protection systems has not been determined as a baseline requirement for BEB implementation and would be left up to the discretion of the local fire marshal and the local building officials. The need for additional fire lanes or fire 'breaks' within long continuous rows of bus parking may need to be discussed with the local fire department but is unlikely considering the size of the fleet stored onsite and the relatively open nature of the site with drive aisles between all of the bus parking.

If BFT decides to install photovoltaic solar canopies above the buses parking stalls, an NFPA 13 compliant automatic sprinkler system could be required because the canopy has a 'use' underneath it as defined by the Washington State Fire Code.

Furthermore, all modifications to the facility should be reviewed with the local Authorities Having Jurisdiction (AHJs), in particular the fire marshal. Fire truck access to the site and hydrant access will need to be reviewed and approved by the pertinent AHJs prior to implementation of any additional infrastructure for charging equipment or solar canopies. However, since the site is designed for bus movements, fire truck access is relatively straightforward and should be accommodated without significant changes to the facility.

In summary, no fire protection systems are required for minimal BEB implementation but considerations for covered canopies could trigger additional fire protection system upgrades to the facilities.

6.6 FALL PROTECTION AND SAFETY INFRASTRUCTURE CONSIDERATIONS

Fall protection systems are recommended for any vehicle maintenance and inspection shop but considering that BFT has already implemented a fall-arrest system in the facility, it is unlikely that additional fall protection systems would be required to safely access the rooftop of buses for potential battery inspection and maintenance. If considerable rooftop access is necessary in the future, the agency should consider additional fall protection systems throughout the shop.

6.7 BACKUP PLANNING

Transit agencies need to consider the portion of service (and thus of their BEB fleet) that will be deployed or operated during grid-outage conditions. This percentage will require backup power to charge for the anticipated emergency period. Some transit agencies consider the use of a battery electric storage system (BESS) to provide temporary relief; however, these additional assets are capital intensive and require favorable energy policies to compensate such facilities for the additional services a BESS can provide.

For the purposes of the site planning and cost estimating, Stantec assumed back-up power will be provided via two diesel fired 3,000 kW generators with a storage capacity for 4,000 gallons of diesel (each) in order to serve one revenue day at 100% service levels. See Figure 27 for example generator installation. Natural gas or propane fired generators are not feasible as only diesel fueled generators exist at this size.

Figure 27: Typical stationary backup diesel generator with belly tank fuel storage.

If BFT wishes to operate for more days during an emergency, the size of generator will stay the same, but the required quantity of fuel will scale linearly. The total amount of fuel required to be stored onsite will depend on the anticipated duration of the utility electrical outage and the amount of time required to get a fuel delivery of diesel fuel, as well as on environmental regulations and local policies.

Adequate space is available on-site for either new permanent generators or accommodations for mobile generators with load bank connections. The generators are placed relatively close to their respective distribution panels. The locations were determined to attempt to minimize the reduction of parking and not impact the storm water swales on the site. The proposed generator locations are indicated in Figure 25 and Figure 26. If permanent generators are installed, bollards should be installed surrounding the entire electrical equipment yard, but if a mobile generator is chosen as the preferred method of backup power, then the protective elements should be installed in a manner to allow a mobile generator to be parked near the load bank cabinet to minimize the connection cable distance.

This generator will be an EPA Tier 2 device certified for standby use only. Generator will operate only during loss of utility power and for a limited duration for the purpose of testing and maintenance. Due to its size, it will likely require a permit with the Washington Department of Ecology to operate on ultra-low sulfur fuel only.

6.8 SOLAR PV

Planning for resiliency and redundancy is necessary not only to support operations during emergencies or other disruptions, but also to ensure that if the yard loses power, BEBs can still be operated. While diesel-fired generators will provide emergency backup power, BFT is also interested in exploring renewables, such as solar energy generated through photovoltaics (PV).

Several agencies have deployed solar PV assets to generate renewable energy to power functions like administration buildings. With the adoption of a BEB fleet, additional harvesting of solar PV energy, together with storage of this energy in stationary batteries, can be used to charge a portion of the fleet with energy that does not come ‘from the grid’. As such, this strategy could be used to diminish some of the costs associated with charging, particularly during peak time-of-use periods.

Nevertheless, solar arrays and stationary batteries have limitations. The power generated with solar PV arrays will likely account for a small portion of the energy requirements of a BEB fleet, and in the case of stationary batteries, once they have been discharged to charge a BEB, they need to be recharged, which typically takes several hours. In the event of an emergency, relying solely on solar energy is impractical. As such, deploying complementary fossil fuel-powered generators is necessary to generate the power required to charge a BEB fleet.

The analysis of potential solar PV energy generation and the costs of ownership of these potential assets is provided in Appendix D: Solar Analysis. In terms of implementation, the plan developed here does not include solar PV and/or stationary BESS. BFT can, in the future as it deploys BEBs, can re-examine the practicality and economics of a solar PV and/or stationary BESS system.

7.0 TRANSIT CENTER MODIFICATIONS: ON-ROUTE CHARGING REQUIREMENTS

This section outlines the proposed modifications for on-route charging for BEB implementation at BFT's transit centers if BFT transitions 100% BEBs. As the current BEBs are limited by their range on a single charge, installing on-route chargers at BFT's transit centers would permit range extension and resiliency if rapid charging is required. If BFT deploys FCEBs, then on-route chargers are unlikely to be needed.

The conceptual master plan options have been developed proposing gantry mounted, pantograph-down dispensers. All three transit centers consider the charging locations as layover positions, not within the passenger loading bus bays adjacent to the passenger platforms.

The transit centers are all open-air with limited above ground structures around the perimeter. The proposed layover locations are shown in each of the master plan concepts with the primary goal of not impacting passenger loading or functionality of the bus bays while respecting the traffic patterns and flow of the transit centers. Each facility has a slightly different approach, but sufficient space is available for the charging equipment and associated electrical infrastructure upgrades.

7.1 CURRENT TRANSIT CENTER UTILITY CONSIDERATIONS

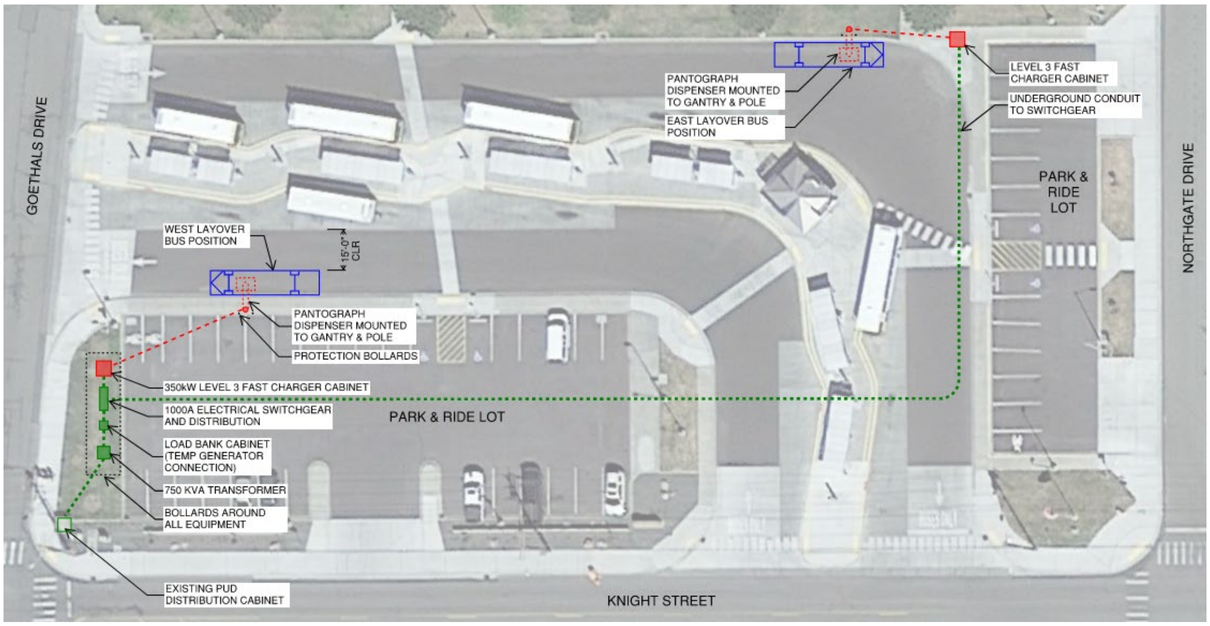
Currently, the service at any of the transit centers would not be sufficient to provide any chargers, particularly the high-power chargers required for on-route opportunity charging. As such, all transit centers require electrical upgrades and investments. In the interim, BFT could deploy BEBs on routes and assignments that fit comfortably within the operating ranges of BEBs and focus on overnight recharging at the depot.

7.2 KNIGHT STREET TRANSIT CENTER

- The following summarizes the proposed improvements for the Knight Street Transit Center (Figure 28):
- A new 750 kVA transformer and 1,000 A switchboard to provide power to the chargers, along with associated equipment pads and bollards.
- For emergency backup in case of power outage, a new 1,000 A connection cabinet for a portable, temporary generator connection is recommended. Generator would need to be parking in the park and ride lot, reducing parking capacity.
- Two 350 kW, level 3 fast chargers (pantograph, SAE J3105-compliant) with a 1:1 charger-to-dispenser ratio.
    - Equipment pads, associated bollard protection, and dispenser gantry poles.
    - Power main feeder and sub feeders
    - Communication system panel/distribution cabinet and conduits to each charger
    - All service conduit connecting the power cabinets to the gantry dispensers will be underground.

- Pavement replacement/repair for trenching associated with electrical distribution for locations where new electrical service and switchboard will be allocated.
- Connection to adjacent PUD distribution cabinet at corner of Knight Street and Goethals Drive.
- No proposed modifications to the passenger loading areas

Figure 28: Knight Street Transit Center Conceptual Master Plan and platform.



7.3 22ND AVE TRANSIT CENTER

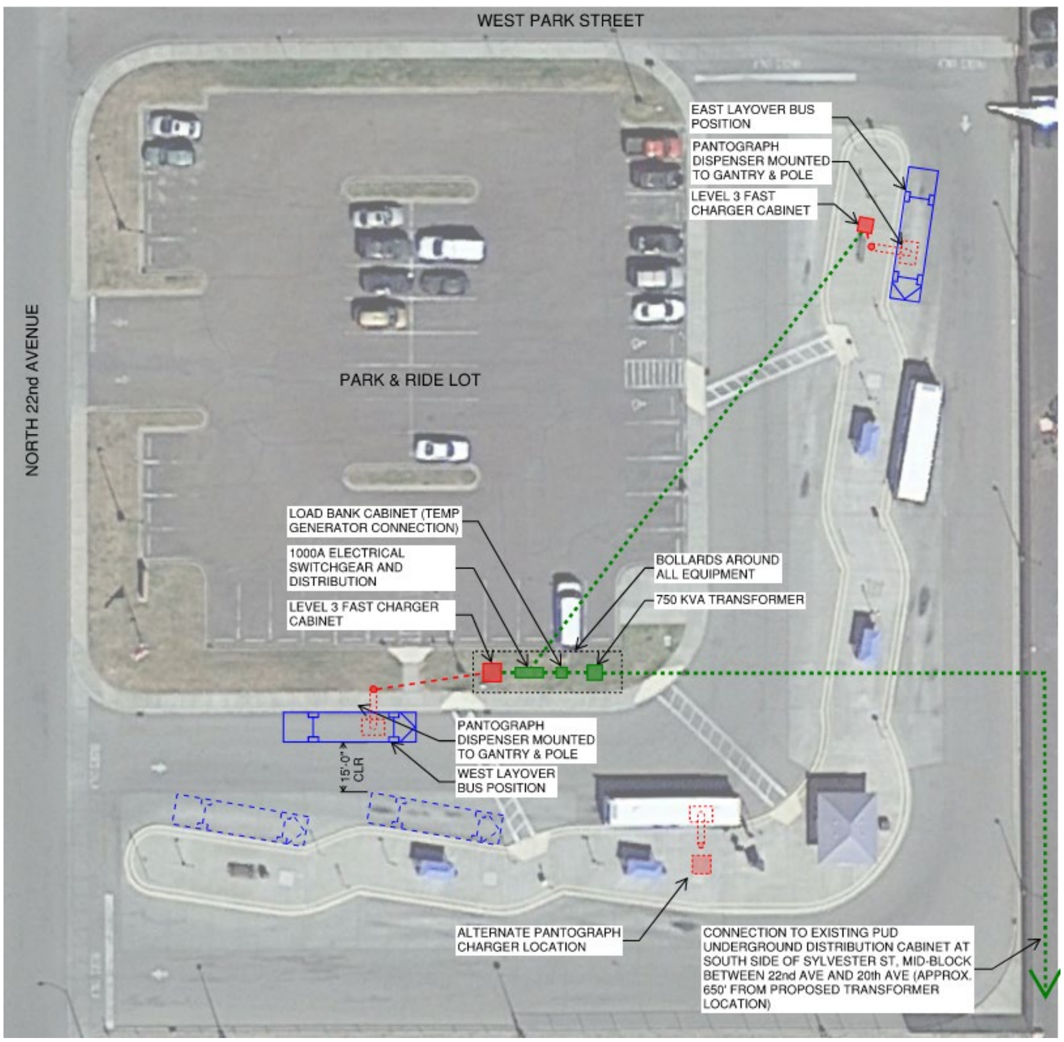
The following summarizes the proposed improvements for the 22nd Avenue Transit Center (

Figure 29):

- A new 750 kVA transformer and 1,000 A switchboard to provide power to the chargers, along with associated equipment pads and bollards.
- A new 1,000 A temporary generator connection cabinet. Generator would need to be parking in the park and ride lot, reducing parking capacity.
- Two 350 kW, level 3 fast chargers (pantograph, SAE J3105-compliant) with a 1:1 charger-to-dispenser ratio.
    - Equipment pads, associated bollard protection, and dispenser gantry poles.
    - Power main feeder and sub feeders
    - Communication system panel/distribution cabinet and conduits to each charger

  - All service conduit connecting the power cabinets to the gantry dispensers will be underground.
- Pavement replacement/repair for trenching associated with electrical distribution for locations where new electrical service and switchboard will be allocated.
- Connection to existing underground PUD distribution cabinet on the south side of Sylvester Street, approximately mid-block between 22nd Avenue and 20th Avenue (about 650-ft from proposed transformer location).
- Minor modifications to the passenger loading platform for one of the chargers and associated gantry. At least one of the two chargers will need to be on the platform if west-bound buses are to utilize one of the chargers.

Figure 29: 22nd Ave Transit Center Conceptual Master Plan

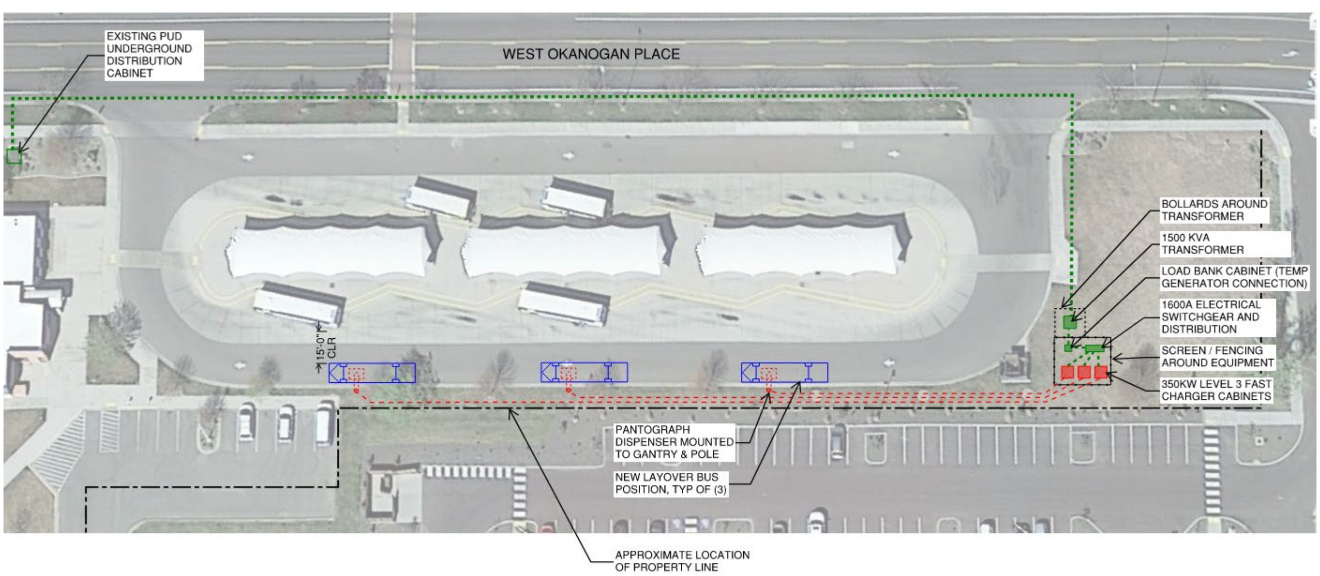


7.4 THREE RIVERS TRANSIT CENTER

The following summarizes the proposed improvements for the Three Rivers Transit Center (Figure 30):

- A new 1,500 kVA transformer and 1,600 A switchboard to provide power to the chargers, along with associated equipment pads and bollards.
- A new 1,600 A temporary generator connection cabinet. Generator would need to be parking in the park and ride lot, reducing parking capacity.
- Three 350 kW, level 3 fast chargers (pantograph, SAE J3105-compliant) with a 1:1 charger-to-dispenser ratio. Since the transit center allows for off-street circulation, all three chargers are proposed to be located along the south side of the transit center on the outer curb of the loop. Buses will be able to pull into the transit center from either direction, loop around and parallel park along the curb to charge.
  - Equipment pads, associated bollard protection, and dispenser gantry poles.
  - Power main feeder and sub feeders
  - Communication system panel/distribution cabinet and conduits to each charger
  - All service conduit connecting the power cabinets to the gantry dispensers will be underground.
- Pavement replacement/repair for trenching associated with electrical distribution for locations where new electrical service and switchboard will be allocated.
- Connection to existing underground PUD distribution cabinet in front of the transit center building along West Okanogan Place.
- No proposed modifications to the passenger loading areas and platform.
- Given the adjacency of this transit center to neighboring businesses and uses, additional screening and/or fencing around the charging and electrical equipment may be a consideration.

Figure 30: Three Rivers Transit Center Conceptual Master Plan



8.0 NEXT STEPS WITH UTILITIES

With the information presented above, BFT now needs to work with local utilities and jurisdictions to start implementing the charging infrastructure needed to successfully operate ZEBs. The key next steps include:

- Implementing a large scale BEB infrastructure project at the maintenance facility will require close coordination with the local utility, Richland PUD. In preliminary discussions with the utility the current feeders located at Columbia Park Trail have limited capacity available. Utility upgrades to support the BEB utility service could exceed the rate allowance from Richland PUD and require additional initial costs for BFT.
- BFT will need to request a service study from Richland PUD with a projected load growth. These studies typically take about 6 weeks and a fee of ~$2,000. The study will identify the utility upgrades required with an estimated cost required from both the utility and the owner. Prior to installation of the BEB electrical service, a new service request will need to be submitted to Richland PUD to proceed with procuring and installing the upgrades form the study.
- The existing service at all three transit centers for site lighting and other small loads will not be sufficiently large to support any BEB infrastructure. Stantec has confirmed with each local utility that they have capacity in the area to support a new 1,500 KVA service.
- Before installation at Knight Street transit center, BFT must submit a new service request with Richland PUD for the design and procurement of the new service equipment, including any new utility owned transformers.
- Similarly, for 22nd Ave transit center a new service request will need to be submitted with Franklin County PUD.
- For Three Rivers transit center the new service request will need to be submitted to Benton County PUD
- Construction costs of the utility owned service equipment will be captured in the rate allowance of that new service, with no initial fee for BFT.

9.0 FINANCIAL EVALUATION AND IMPACTS

The financial evaluation for BFT's ZEB rollout plan consisted of the modeling of a Base Case (assuming continued use of diesel vehicles or 'business-as-usual') and a ZEB Rollout scenario (assuming a transition to 100% ZEB operations and the phasing out of diesel vehicles), and a comparison between the two scenarios to quantify the financial impacts of the transition and of ZEB operations. Stantec's cost estimator, Jacobus & Yuang, Inc., provided a detailed cost estimate of materials, soft costs, constructions, and other line items related to facility and transit center modifications for the ZEB case (more information in Section 6.0 and Section 7.0).

The main assumptions for the cost modeling are:

- Financial modeling was completed in real 2022 dollars (2022$).
- A 7% discount rate was applied for all calculations, as per USDOT guidance.
- The chief source of information regarding fleet planning is BFT's Transit Development Plan, BFT's Climate Action Plan, and BFT's future procurement plans. Stantec worked with BFT staff to revise the phasing plan to account for fleet expansion for potential service improvements and other operational growth between 2023 and 2040.
- Annual average vehicle mileage is as follows for each vehicle type[6]:
    - 40,134 miles for 40-ft. vehicles
    - 46,533 miles for 35-ft vehicles
- Average fuel economy as follows (based on BFT information for existing feet and Stantec modeling for the ZEBs):
    - 4.3 miles per diesel gallon equivalent (DGE) for 40-ft and 35-ft diesel vehicles
    - 0.45 miles per kWh for 40-ft BEBs
    - 0.52 miles per kWh for 35-ft BEBs
- The ZEB case included the operation of diesel vehicles (as well as BEBs) during the transition period until fossil fuel vehicles are phased out.
- The model was completed using a consistent format for both the Base Case and the ZEB Case to facilitate clear comparisons between the two. The modeling was developed on an annual basis from 2023 to 2040.

[6] Based on NTD 2020 reported statistics.

More details about the assumptions and inputs for both the Base Case and ZEB Case can be found in Appendix A: Financial Modeling Inputs and Assumptions.

9.1 BASE CASE APPROACH

Stantec developed the forecast for the Base Case (business-as-usual) scenario, assuming that the existing diesel fleet is maintained and renewed through 2040. This model is inclusive of all scheduled fleet replacements and expansions during the 2040 project horizon. The purpose of the Base Case is for illustrative purposes to determine the comparative financial impacts of a ZEB rollout.

Capital expenses modeled consist of fleet acquisition based on BFTs Transit Development Plan.

Vehicle maintenance costs were derived from NTD 2020 data based largely on salaries, tires, and other materials; costs were developed as a cost per mile. Diesel fuel costs are based on information provided by BFT.

9.2 ZEB CASE APPROACH

The ZEB Case proposes a gradual transition to 100% BEB operations by 2040. The transition follows the fleet replacement schedule presented in Table 12.

The fleet phasing plan assumes that BFT will begin procuring BEBs in 2023 and will not purchase any more diesel buses to achieve a full ZEB transition by 2040. The assumed life cycle for the ZEB vehicles were the same as current lifecycles for non-ZEB vehicles, which BFT has specified a useful life of 14 years. Nonetheless, BFT will reassess the appropriateness of the useful life guidance of ZEBs as it gains first-hand experience operating and maintaining newer generation ZEBs and revise its deployment plan accordingly.

Capital expenses modeled consist of fleet acquisition, and battery replacements at the vehicle's mid-life (seven years) based on OEM information. The battery replacement would be covered by the extended warranty purchased with the vehicle during initial procurement.

Vehicle maintenance costs for BEBs were generated based on BFT's current costs for its diesel fleet. The lack of data on maintenance costs, particularly for costs outside of an OEM warranty, makes maintenance costs difficult to forecast.

Electricity costs were calculated based on the expected rates from Richland PUD for in-depot charging, City of Richland PUD for charging at the Knight Street Transit Center, Franklin County PUD for charging at the 22nd Ave Transit Center, and Benton County PUD for charging at the Three Rivers Transit Center calculated by Stantec based on BFT's fleet and operational profiles.

Infrastructure costs for the ZEB case are related to facility modifications to accommodate BEBs and the related charging infrastructure, as well as infrastructure costs at the three transit centers that will host on-route charging. The related infrastructure is detailed in Section 6.0 and Section 7.0.

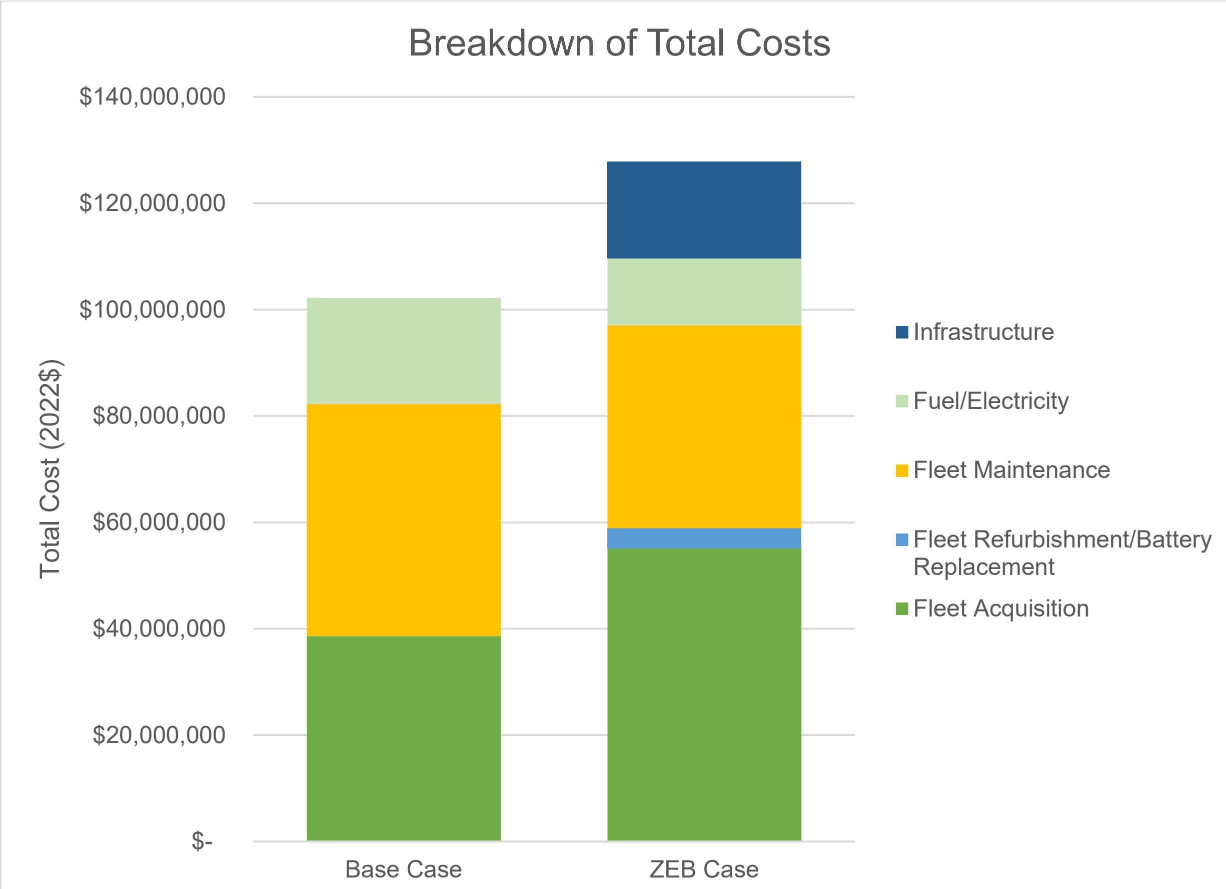
9.3 COMPARISON AND OUTCOMES

The cost comparison between the diesel Base Case and the ZEB Case transition scenario is presented in Table 17 and Figure 31, incorporating both capital (orange) and operating (blue) expenses. The ZEB Case has a total cumulative cost of $127,819,000 versus $102,207,000 for the Base Case, a difference of $25,612,000 or a 25% increase. The financial assessment does not consider any rebates, grants, credits, or other alternative funding mechanisms. Therefore, there may be several opportunities to offset the difference in the price between the two scenarios. Potential funding sources are discussed in Section 13.0.

Table 17: Cost Comparison 2023-2040

	Base Case	**ZEB Case**	**Cost difference (ZEB – Base)**
Fleet Acquisition	$38,624,000	$55,132,000	$16,508,000
Fleet Refurbishment/Battery Replacement	$-	$3,733,000	$3,733,000
Infrastructure	$-	$18,141,000	$18,141,000
Fleet Maintenance	$43,634,000	$38,158,000	$(5,476,000)
Fuel/Electricity	$19,949,000	$12,655,000	$(7,294,000)
Total	**$102,207,000**	**$127,819,000**	**$25,612,000**

Figure 31: Breakdown of Cost Categories for the Diesel Base Case and ZEB Case Scenarios



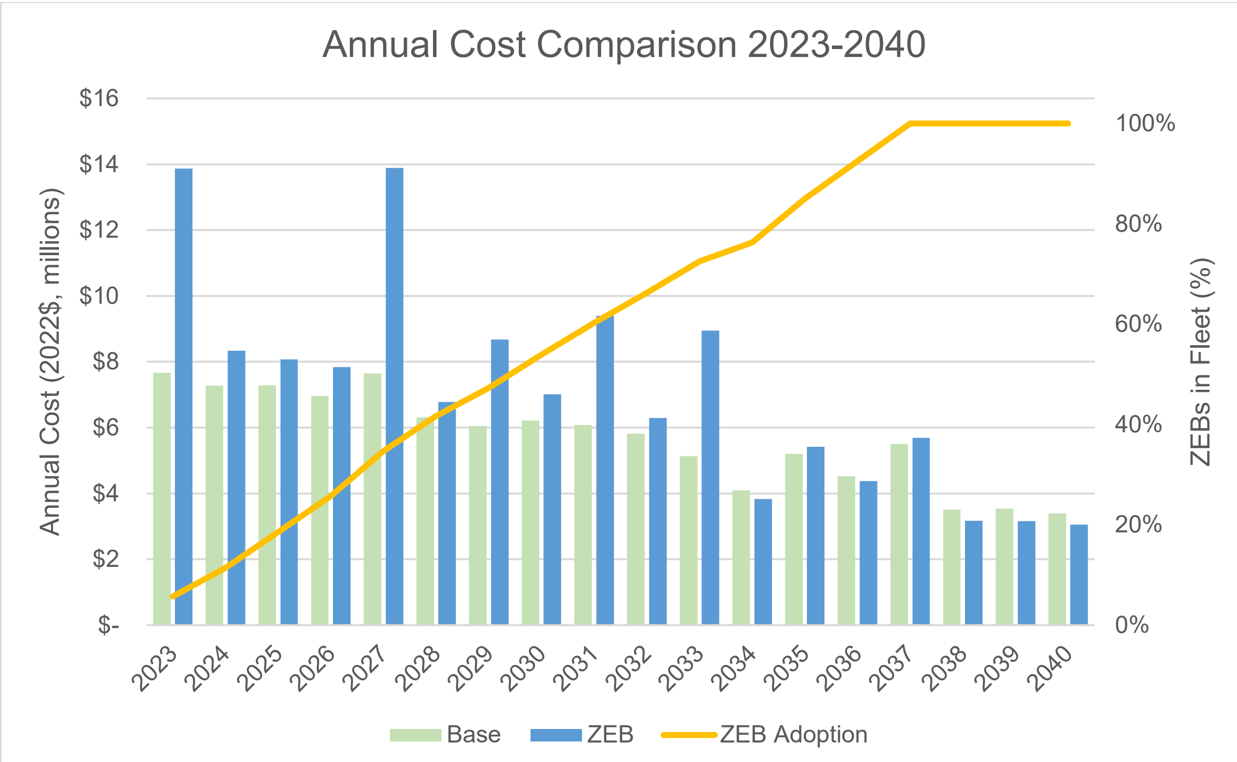
The procurement of ZEBs represents $16.5 million more in expenses due to the higher purchase price of ZEBs compared to diesel vehicles. The conversion and upgrades to the facility to install charging infrastructure and on-route charging infrastructure at the three transit centers represents another added cost of $18.1 million.

Capital costs associated with vehicle overhauls and battery replacements are relatively minor in comparison, although the simplicity of ZEB propulsion systems means that these costs are lower for this technology compared to diesel engine components in the Base Case. This also translates to lower maintenance cost for the ZEB fleet, a savings of $5.5 million compared to the Base Case.

Lastly, the use of electricity as a 'fuel' represents an economic benefit of $7.3 million when compared to the existing diesel refueling. These savings are a direct reflection of the improved efficiency that ZEBs have with respect to old technologies, with the added benefit of eliminating emissions. Hydrogen, on the other hand, depending on the unit cost, may be on par with diesel fuel costs.

Figure 32 shows the year-to-year comparison between the Base Case and the ZEB Case. The higher costs for the ZEB scenario occur during the years that new modifications are conducted at the yard and transit centers and when a higher purchase of vehicles is made (2023, 2027, 2029, 2031, and 2033).

Figure 32: Annual Total Cost Comparison



10.0 OPERATIONAL AND PLANNING CONSIDERATIONS

This section provides guidance and strategies for various operational and planning requirements when implementing BEBs.

10.1 PLANNING, SCHEDULING, AND RUNCUTTING

According to the phasing schedule, the first ZEBs to be introduced will be 2023, but construction and deployment of chargers will need to be occur prior to that, preferably at least 6 months prior to acquisition.

Key considerations for BEB planning and scheduling include the fact that the useable energy of the battery is 80% of the nameplate capacity. In other words, while BFT may purchase buses that have a 660-kWh battery, for instance, it should plan for 80% of that capacity or ~528 kWh. This fact, together with the modeling conducted by the Stantec team in this study, will help guide the deployment and charging parameters for BEBs in BFT's operations scheduling.

Developing a 'cheat sheet' like the depot planning tool from Siemens below (Figure 33) that tracks the requirements for SOC, energy (kWh), estimated and planned mileages, and fuel economy (kWh per mile) will be important for planning and dispatching.

Figure 33: Depot planning tool to understand scheduling and operations of BEBs (Source: Siemens).

Example – 4 buses and 2 chargers c/w 2 dispensers each

Parameter	Value	Notes
	filter data...	
Scheduled buses	4 / 4	
Used chargers	2 / 2	
Total energy required, KWh	969.2544	
Total energy delivered, KWh	1091.76	
Maximum power, KW	105.11	

BusID	Capacity, KWh	EleCon, KWh/km	Planned distance, km	Max distance, km	SoC start, %	SoC end planned, %	SoC end expected, %
filter data..							
191	349	1.29	195.79	243.48837209302326	17	90	90
192	349	1.29	179.89	243.48837209302326	23	90	90
193	349	1.29	179.89	243.48837209302326	23	90	90
194	349	1.29	195.79	243.48837209302326	17	90	90

Non-revenue tests during vehicle commissioning should be conducted in different parts of BFT's service area to ascertain actual range and fuel economy on longer routes, routes with topography variations, and with simulated passenger loads and HVAC testing. Regarding HVAC testing, it is important to keep in mind that energy consumption varies with seasonality.

Training for the scheduling and planning team will be needed so that they understand the importance of scheduling BEBs to the correct blocks. Training will also likely be needed in collaboration with BFT's scheduling software provider to account for combined BEB, diesel, and finally an entirely-BEB operation.

Factoring in on-route charging into bus assignments and operator schedules will also be necessary and should be detailed on operators' run sheets. The on-route charging plan should be accommodating enough to allow a bus to miss at least one charge throughout the day without impacting service delivery.

In the long term, it is also important to consider battery capacity degradation early on, as most BEB battery warranties specify that expected end of life capacity is 70% to 80% of the original capacity over six-twelve years[7]. With an estimated 2% battery degradation per year BFT will also need to rotate buses so that older buses are assigned shorter blocks, while newer BEBs are assigned the longest blocks. Transit agencies can improve battery outcomes through efforts like avoiding full charging and discharging events, avoiding extreme temperature exposure, and performing regular maintenance on auxiliary systems that consume energy. Given the temperature extremes in the Richland area, BFT will need to carefully monitor battery health and degradation levels accordingly.

Developing specific performance measures, goals, and objectives for BEB deployment can also help to track BEB progress and understand if adjustments to the BEB deployment strategy will be required.

10.2 OPERATOR NEEDS

As BEBs have different components and controls than conventional buses, BEB bus performance also differs. Operators should understand how to maximize BEB efficiency—mastering regenerative braking and handling during slick conditions—and have practice on how to do so prior to ZEB deployment for revenue service. Operations staff should also be briefed on expected range and limitations of BEBs (such as variability in energy consumption from HVAC under different weather conditions) as well as expected recharging times and procedures.

BEB operators should be able to understand battery SOC, remaining operating time, estimated range, and other system notifications as well as become familiar with the dashboard controls and warning signals. In addition, operators should be familiar with the correct procedures when a warning signal appears.

It is well known that driving habits have a significant effect on BEB energy consumption and overall performance and range (i.e., fuel economy can vary significant between operators). Operators should become knowledgeable on the principles of regenerative braking, mechanical braking, hill holding, and roll back. Operators should be trained on optimal driving habits including recommended levels of acceleration and deceleration that will maximize fuel efficiency. Another option is to implement a positive incentive program that encourages operators to practice optimal driving habits for BEBs through rewards like priority parking in the employee lot, certificates, or other incentives. The Antelope Valley Transit Authority (AVTA) in Lancaster, California, an early adopter of BEBs, has a program of friendly competition between operators, where, for instance, an operator with the best average monthly fuel economy (the lowest kWh per mi) gets one month of a preferred parking spot in the employee lot.

Finally, BEBs are much quieter than conventional fuel buses. Operators should be aware of this and that pedestrians or people around the bus may not be aware of its presence or that it is approaching.

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[7] National Academies of Sciences, Engineering, and Medicine 2020. Guidebook for Deploying Zero-Emission Transit Buses. Washington, DC: The National Academies Press. https://doi.org/10.17226/25842.

Agencies have also stated that due to the vehicle's lack of noise, some operators forget to turn off the bus after parking. Operator training should include a process for ensuring that this happens.

10.3 MAINTENANCE NEEDS

Early data suggests that ZEBs may require less preventative maintenance than their diesel counterparts since they have fewer moving parts; however, not enough data currently exists to provide detailed insights into long-term maintenance practices for large-scale ZEB deployment in North America. One early finding is that spare parts may not be readily available, so one maintenance consideration is to coordinate with OEMs and component manufacturers to develop spare parts inventories and understand lead times for spare parts. It will also be important for BFT to coordinate spare parts procurement needed for ongoing BEB maintenance sooner rather than later so maintenance can be completed without interruption.

In terms of preventative maintenance, BEB propulsion systems are more efficient than internal combustion (IC) engines and thus can result in less wear and tear. Without the diesel engine and exhaust, there are 30% fewer mechanical parts on a BEB. BEBs also do not require oil changes and the use of regenerative braking can help to extend the useful life of brake pads. Early studies from King County Metro show that the highest percentage of maintenance costs for BEBs came from the cab, body, and accessories system. It is recommended that BFT require OEMs to provide a list of activities, time interval, skill needed, and required parts needed to complete each preventative maintenance task for BEBs.

Many current BEBs also contain on-board communication systems, which are helpful in providing detailed bus performance data and report error messages, which can assist maintenance personnel in quickly identifying and diagnosing maintenance issues.

10.4 CHARGING NEEDS

BEB recharging is substantially different than fueling a diesel or fossil fuel bus. As part of the recommendations, plug-in chargers (150 kW) are proposed for BEB charging at the main operations and maintenance facility. Once BEBs return to the yard and are parked, a service line technician would plug in the dispenser to recharge the bus. Smart charging software, described in Section 11.0 below would monitor and control overall charging levels to balance energy needs with overall power demand, in essence helping ensure that BEBs are charged but that this charging is spread out to avoid large surges in power demand.

Figure 34: A BEB plugged into a charger in Charleston, SC.

At the transit centers, to enable the long service blocks of BFT's service, on-route pantograph chargers with outputs of 350 kW would be used to top-up a BEB to extend its operating range. According to the modeling, not every route or block requires on-route charging. Furthermore, not every trip would require a top-up. Refinement of vehicle scheduling and on-route charging will need scrutiny to ensure that vehicles are recharged appropriately and that pantographs are not 'overscheduled' in the sense that charging should be scheduled to minimize any operational impacts to bus service, as well as continue the facilitation of passenger transfers between vehicles/routes.

Figure 35: A BEB recharging during a layover in Los Angeles, CA.

Regarding charger maintenance, research suggests that depot charging stations require minimal maintenance. Depot charging stations that are modular in design allow malfunctioning components to be replaced without disruption to the entire charging system.

At the transit centers, safety precautions for working at heights will be necessary to service pantograph charging dispensers. A malfunction of the pantograph is a significant risk to service if a BEB cannot charge; the recommendations in this plan include a contingency charger at each transit center to help mitigate some of that risk.

11.0 SUPPORTING TECHNOLOGY

Technology for ZEBs will help BFT manage the fleet and its investment into zero-emission propulsion. First, for BEBs, charge management or smart charging technology is imperative to manage electrical demand and to curb potentially costly demand charges and to mitigate maximum power requirements of bus charging. Second, fleet tracking software typically provided by an OEM will help track useful analytics related to the fleet and operations to help BFT make informed decisions.

11.1 SMART CHARGING

To optimize BEB charging by minimizing charging during peak times of the day and to restrain the total power demand required for a BEB fleet, transit agencies deploy **smart charging**. Smart charging refers to software, artificial intelligence, and switching processes that control when and how much charging occurs, based on factors such as time of day, number of connected BEBs, and SOC of each BEB. This requires chargers that are capable of being controlled as well as a software platform that can effectively aggregate and manage these chargers. A best practice is to select chargers where the manufacturers are participants in the Open Charge Point Protocol (OCPP), a consortium of over 50 members focused on bringing standardization to the communications of chargers with their network platform.

A simple example of smart charging is if buses A, B and C return to the bus yard and all have an SOC of about 25%, all have 440 kWh battery packs, and all are plugged in in the order they arrived (A, B, C, though within a few minutes of each other). Without smart charging, they would typically get charged sequentially based on arrival time or based on SOC, with A getting charged first in about 2.2 hours, then B would be charged after 4.4 hours, and C about 6.6 hours. But if bus C is scheduled for dispatch after three hours, it would not be adequately charged.

But by implementing smart charging, the system would ‘know’ that bus C is to be dispatched first and therefore would get the priority, would be charged first in 2.2 hours, and would be ready in time for its ‘hour three’ rollout.

Another implementation is to mitigate energy demand when possible. For example, if two buses are each connected to their own 150 kW charger and they both need 300 kWh of energy and if the buses do not need to be dispatched for five hours, the system will only charge one bus at a time, thus generating a demand of only 150 kW, while still fully charging both buses in four hours. However, if both buses need to be deployed in two hours, the system will charge both simultaneously as needed to make rollout. A smart charging system would help optimize costs by also avoiding or minimizing charging during the most expensive times of day and help curb potential demand charges.

Well-planned and coordinated smart charging can significantly reduce the electric utility demand by timing when and how much charging each bus receives. Estimations on the ideal number of chargers is critical to the successful implementation of smart charging strategies.

There are several offerings in the industry for smart charging, charger management, and fleet management from companies such as ViriCiti, I/O Systems, AMPLY Power, Evenergi, and Siemens.

Additionally, the charger manufacturers all have their own native charge management software and platforms. These platforms have management functionality and integration that often exceeds the abilities of the other platforms and provide data and functionality similar to that of the third-party systems, particularly in the yard when BEBs are connected to the chargers. However, the third-party platforms provide more robust data streams while the BEBs are on route, including real-time information on SOC and usage rates. These platforms can cost well over $100 per bus per month, depending on the number of buses, and type of package procured.

Three leading charge management system (CMS) providers have been evaluated as shown in Table 18. Information within this table was provided by the providers. This table indicates this point in time—at the time of procurement the features and criteria should be verified with the provider. Note that Viriciti was purchased by ChargePoint in 2021, the intent is to operate Viriciti separately from ChargePoint. A Buy America evaluation will be required for these providers.

Table 18: Charge Management System Vendor Comparison

Item No.	Criteria Description	Amply Power - OMEGA	Viriciti - Agnostic Management Platform	ChargePoint - CMS
1	Number of installations (facilities) with multiple HVDC chargers utilizing the software	14	More than 300	300+
2	Quantify uptime % of cloud base service	99.99%	99.99%	99.99%
3	What networking protocols or modes are supported, i.e., wired Ethernet, cellular, other	Hardwired ethernet is recommended, cellular and facility WIFI are supported	Cellular is recommended, wired Ethernet, and WIFI are supported	Cellular
4	OCPP 1.6 compatibility	Yes	Yes	Yes
5	OCPP 2.0 compatibility	Yes	Yes	Yes
6	List available data fields that can be reported (such as starting and ending SoC, bus ID, charging power, …)	SOC: start and end of charging session, SOC all the time whether bus in plugged in, parked or in the field. Rate of charge (kW) of each charger port. Bus ID all the time whether bus is plugged in or not. Location of bus (in-depot, in field, etc.) Charging session: Energy dispensed Duration of charging, Power and energy consumed at electrical meter and dispensed at each charger port. Charger health: Available Faulted Maintenance needed, etc.	Reports: Uptime, Downtime, and Offline chargers (in hours, percentage, and total for a group) Energy Reports (in kWh and hours of duration) Transactions: Charger OEM, Charger Name, Connector type, Connector/port number (1 or 2) Vehicle Name/Number Start Time and End Time Start SOC and End SOC Power Reason for ending charge session Duration of Charging session kWh Charged Range at start of transaction Range at the end of the transaction A visual graph representation of Power, SOC, and Energy throughout each transaction A complete list of charging transactions (equipped with the data previously stated) A complete list of user logs and documentation of user interactions.	
7	OpenADR2.0b or better common signals	Yes. In addition to OpenADR, also support custom DR integrations including CPower and Leap Energy.		Yes

Item No.	Criteria Description	Amply Power - OMEGA	Viriciti - Agnostic Management Platform	ChargePoint - CMS
8	Support Network Time Protocol (NTP/UTC) time synchronization	Yes	Yes	Yes
9	Describe software security features for system integrity and reliability	AMPLY has implemented security procedures at multiple levels for protecting customer information: • AMPLY databases are encrypted using industry standard AES-256 encryption • Both the database and application are running inside a VPC which has tightly managed access using IAM • The database is accessible only to the application nodes • No passwords are stored in the database and authentication is done using AWS Cognito • Authorization is tightly managed as part of the lower layers of the Amply software framework • Credentials are not stored in the database or code and are managed via the AWS systems manager • Software packages and dependencies are regularly reviewed for security vulnerabilities • Cloud infrastructure, roles & security groups are regularly reviewed for ensuring security		ISO 27000:2015
10	Capable of remote software upgrades	Yes – automatic, over the air updates	Yes – Updates happen though the Cloud	Yes
11	Is user interface web based or is any local app or software required	Web based UI accessible from any web enabled device	The system operates through a cloud-based platform which can be accessed through any web browser on a computer or mobile device. Web base only.	Web based
12	Ability to set charge-power limit to reduce energy charges while also maximizing bus availability	Yes. Pause or curtail charging session during peak energy costs. Optimized charging during off-peak or vehicle dwell times to achieve target SOC by defined roll-out times.	Yes, this is a customizable application which allows the user to create and manipulate charging parameters as needs or schedules change.	Yes
13	Ability to set charging to minimize demand charges while also maximizing bus availability	Demand (kW) management and reduction to achieve roll-out but will spread out charging. Sequential, dynamics and parallel charging capable (limitations are determined by EVSE not AMPLY system).	Yes, this is a customizable application which allows the user to create and manipulate charging parameters as needs or schedules change.	Yes
14	Ability to recognize bus stall and bus number and evaluate charge needs by block and state of charge (i.e., park management)	Yes	Yes	Yes

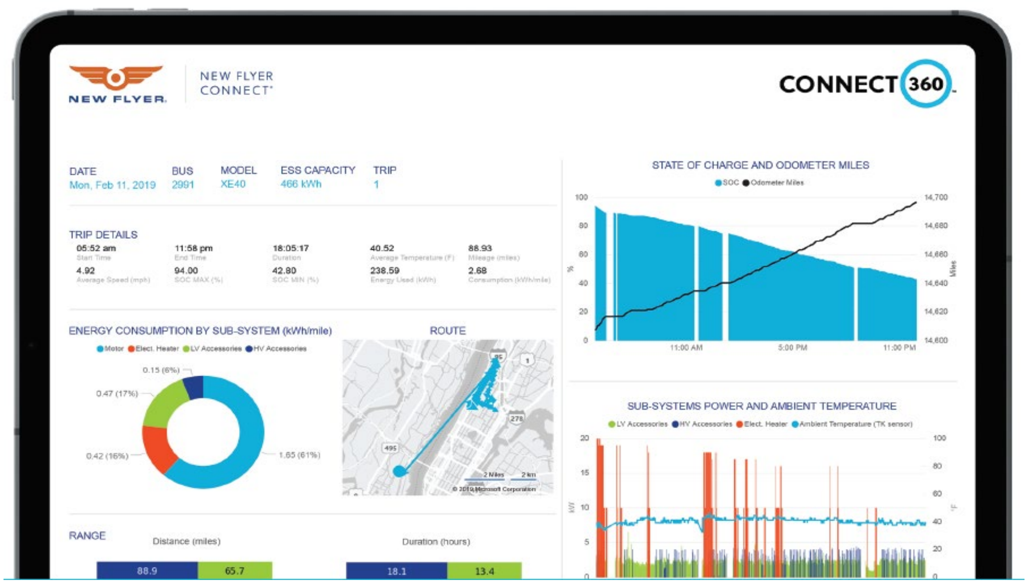
Item No.	Criteria Description	Amply Power - OMEGA	Viriciti - Agnostic Management Platform	ChargePoint - CMS
15	Manual override (computer/HMI input) for selection of (bus) charging sequence	Yes. Manual override button located within UI accessible by a specific user creditable. Override can also be performed by email, phone call or ticket request.	Yes, users can manually prioritize groups of chargers or single chargers in order to meet the demand as needed.	Yes
16	Describe desktop output/reports for charge telematics	• Energy Report - net (panel) load, modelled load (assuming no CMS), aggregate and individual charger load • Charge Detail Records - plug-in and session start & stop times, session duration, session energy, vehicle start & end soc, vehicle ID • Health Records - % normal, faulted, offline and uptime for EVSEs, controllers, system & software components • Vehicle Logs - Geo location and SOC information • Charge Ready Transport - CRT formatted report for PG&E, SCE and other Utilities Fleet Ready Programs	• Uptime, Downtime, and Offline chargers (in hours, percentage, and total for a group) • Energy Reports (in kWh and hours of duration) • A complete list of charging transactions (equipped with the data previously stated) • A complete list of user logs and documentation of user interactions.	No response
17	Is there a local controller to preserve the same control functionality in case cloud connectivity fails (e.g., WIFI outage)?	Yes, AMPLY Site Controller (ASC) installed at electrical main and is connected to breaker. CT's will meter 3- phases of power for real- time demand management. ASC can be hardwired to each EVSE via CAT6 to send OCPP directly to charger. If CMS cellular connection temporarily down, ASC has programmed commands to continue charging until cellular connection is restored.	With all communications we send to the charger, there are two signals that are sent: The set parameter and a failsafe value. If connection is disrupted for any reason or duration of time, the charger will revert to the failsafe value until connectivity is reestablished.	Yes
18	Other features criteria, or comments	OMEGA supports algorithmic optimization across a wide set of use cases in addition to TOU energy management including load management, tariff-based optimization across usage, demand and subscription charges, factoring in unmanaged loads, demand response signals from OpenADR and other providers. It also offers flexible alerting and notifications for EVSE faults and other conditions.	• Provided system is built to scale. If charging needs change or if a new OEM is desired, the system is able to monitor any charging infrastructure (assuming that charger OEM is OCPP compliant) and easily exchange chargers in the system. • Through an API, there is the ability to integrate with other planning or ITCMS platforms to optimize planning. • Other features may include our agnostic telematics system, which is capable of monitoring any vehicle OEM and operates off the same platform as the charger monitoring infrastructure - decreasing operational complexity by reducing software applications and increasing visibility into energy usage/expenditure.	No response

11.2 FLEET TRACKING SOFTWARE

Software like Fleetwatch provides agencies with the ability to track vehicle mileage, work orders, fleet maintenance, consumables, and other items. However, with more complex technologies like BEBs and FCEBs, it becomes crucial to monitor the status of batteries, fuel consumption, and so on of a bus in order to track its performance and understand how to improve fuel efficiency. Many OEMs offer fleet tracking software. While AVL and APCs will continue to play important roles in operations planning, tracking fuel consumption and fuel economy will start to form important key performance metrics for fleet management as well as help inform operations planning (by informing operating, among other elements).

The screenshot below is an example of New Flyer's tool (New Flyer Connect 360; Figure 36), but other OEMs also offer similar tools (like ViriCiti) all depending on an agency's preference.

Figure 36: Example of New Flyer Connect 360.[8]



At a minimum, the fleet tracking software should track a vehicle's SOC, energy consumption, distance traveled, hours online, etc. Tracking these KPIs can help compare a vehicle's performance on different routes, under different ambient conditions, and even by different operators.

When looking at other transit agencies, AVTA operates a near 100% BEB fleet of over 50 vehicles, and collects and reports the following information at its monthly board meetings:

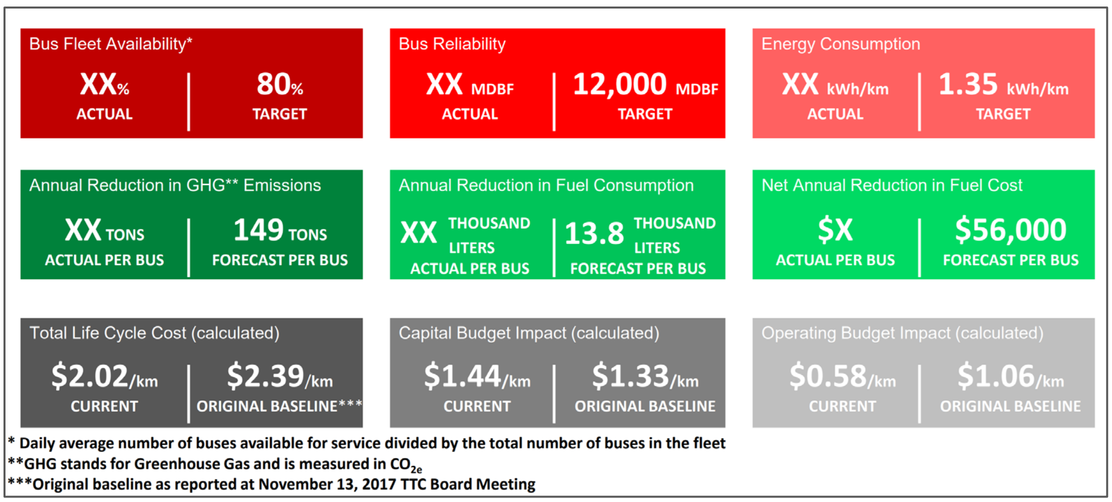
- ZEB vs. non-ZEB miles traveled
- ZEB vs. non-ZEB maintenance cost per mile

[8] https://www.newflyer.com/tools/new-flyer-connect/

- ZEB vs. non-ZEB fuel/energy costs by month ($ per kWh vs. $ per gallon)
- ZEB vs. non-ZEB fuel/energy cost per mile
- Average fuel consumption/fuel economy per month
- Total ZEB vs. non-ZEB fuel and maintenance costs per month
- Mean distance between failures
- ZEB vs. non-ZEB fleet availability

The Toronto Transit Commission (TTC) is currently testing BEBs from three different OEMs and is tracking the following KPIs for its BEBs to compare with its fossil fuel buses (Figure 37).

Figure 37: Example of TTC eBus KPIs.[9]



All BEB equipment should be connected to BFT's current data collection software, networks, and integrated with any existing data collection architecture. All data should be transmitted across secure VPN technology and encrypted.

Beyond the BEB itself, charger data should be collected as well, such as the percentage of battery charge status and kWh rate of charge. Furthermore, it will be important for BFT to track utility usage data from Richmond PUD to understand energy and power demand and costs.

9 https://www.ttc.ca/About_the_TTC/Commission_reports_and_information/Commission_meetings/2018/June_12/Reports/27_Green_Bus_Technology_Plan_Update.pdf

12.0 WORKFORCE CONSIDERATIONS

The deployment of a new propulsion technology will require new training regimes for operators and maintenance staff. This section describes some key training considerations as well as the implications of the adoption of BEBs.

12.1 TRAINING

BEBs manufacturers include basic training modules for bus operators and maintenance technicians that are typically included in the purchase price of the vehicle, with additional training modules and programs available for purchase. BFT maintenance leadership needs to work with staff and the maintenance technician union to understand how best to approach training for BEBs, and whether in addition to basic training from OEMs, additional training is needed. BFT should also leverage any existing institutional knowledge, tools, and techniques used for the maintenance and operations of its legacy BEB.

The minimum required training recommendations are as follows for operators and maintenance technicians:

- BEB Operator training (total 56 hours)
    - Operator drive training (four sessions, four hours each)
    - Operator vehicle/system orientation (20 sessions, two hours each)

- BEB Maintenance technician training (total 304 hours)
    - Preventative maintenance training (four sessions, eight hours each)
    - Electrical/electronic training (six sessions, eight hours each)
    - Multiplex training (four sessions, each session consisting of three eight-hour days)
    - HVAC training (four sessions, four hours each)
    - Brake training (four sessions, four hours each)
    - Energy Storage System (ESS), lithium-ion battery and energy management hardware and software training (six sessions, eight hours each)
    - Electric drive/transmission training (six sessions, eight hours each)

Acquiring the following tools and safety materials should be a top priority to ensure successful in-house ZEB maintenance and management.

- Operational training module
- High voltage interface box
- Virtual training module
- High voltage insulated tools
- Insulated PPE
- Electrical safety hooks
- Arc flash clothing

Table 19 below provides a framework of potential training methods and strategies to bolster BFT's workforce development and successfully transition to a 100% ZEB fleet.

Table 19: Potential training methods

Plan	Description
Train-the-trainer	Small numbers of staff are trained, and subsequently train colleagues. This maintains institutional knowledge while reducing the need for external training.
Bus vendor training and fueling vendor	OEM training provides critical, equipment-specific operations and maintenance information. Prior to implementing ZEB technology, BFT staff will work with the OEMs to ensure all employees complete necessary training.
Retraining & refresher training	Entry level, intermediate, and advanced continuous learning opportunities will be offered to all BFT staff.
ZEB training from other transit agencies	BFT should leverage the experience of agencies who were early ZEB adopters, such as the ZEB University program offered by AC Transit.
National Transit Institute (NTI) training	NTI offers zero-emissions courses such as ZEB management and benchmarking and performance.
Local partnerships and collaborations	BFT could work with local schools to showcase potential careers in bus and facilities management to students.
Professional associations	Associations such as the Zero Emission Bus Resource Alliance offer opportunities for sharing and lessons learned across transit agencies.

The priority in maintenance needs will be the issue of safety in dealing with high-voltage systems. All maintenance personnel in the garage, whether doing servicing, inspection, or repairs and those in other routines (e.g., plugging and unplugging BEBs) must be educated on the characteristics of this technology. One essential component is the provision and mandate of additional Personal Protective Equipment (PPE) beyond that which is required by automotive garage workplace legislated standards or BFT's policies. Examples of such apparel include high voltage insulated work gloves, flame retardant clothing, insulated safety footwear, face shields, special insulated hand tools, and grounding of apparatus that staff may be using. Also, procedures in dealing with accidents and injuries must be established with instructions and warning signs posted.

Current BEBs also contain on-board communication systems, which are helpful in providing detailed bus performance data and report error messages, which can assist maintenance personnel in quickly identifying and diagnosing maintenance issues.

Beyond training related to the operations of the BEB and depot chargers, training will be required for the operators to properly execute on-route charging. This would include training on properly aligning the bus under the pantograph, deploying the charger, and ensuring charging is efficient. The margin of error for bus-charger alignment is small, and improper alignment will result in a missed charge. Maintenance technicians will also need training on repairing and servicing pantograph chargers.

Finally, it is highly recommended that all local fire and emergency response departments be given training as to the layout, componentry, safety devices, and other features of BEBs. This should reoccur every few years, but the specific frequency can be dependent on agency discretion. In addition, agencywide orientation to familiarize the agency with the new technology should also be conducted prior to the first BEBs deployment.

12.2 IMPLICATIONS OF BEBS ON WORKFORCE

Early data suggest that BEBs may require less preventative maintenance than their diesel counterparts since they have fewer moving parts. However, BEBs are so new that there is not enough data to provide detailed insights into long-term maintenance practices for large-scale BEB deployments in North America.

Because BEBs have fewer moving components that can malfunction and require replacement, repair, and general maintenance, transit agencies could theoretically save on maintenance costs because: 1) fewer parts could break and need replacement (capital) and 2) less labor is needed to work on the vehicles (operating). The broader concern is related to a possible reduction in the number of maintenance staff required for an BEB fleet vs. a traditional diesel fleet.

Nonetheless, while a future 100% fleet of BEBs may require a smaller complement of maintenance staff, during the transition period, it is highly improbable that a reduction in staff would be warranted. First, diesel technicians would be required until the last diesel bus is retired; based on the transition schedules explored in this propulsion study, the earliest timepoint would be 2036. Second, existing staff can be trained on BEBs to maximize staff retention. As BEB pilots have demonstrated, the learning curve for maintenance as well as the continuing maturity of the technology means that a robust maintenance program is still needed. Indeed, preventative maintenance is still required for a BEB fleet, and experience from a pilot of BEBs revealed comparable labor hours required for work orders across fleets of BEBs, diesel-hybrids, and diesel buses.

Looking further into the future, it is very challenging to predict staffing levels for BEBs. As technology matures and becomes more technologically sophisticated, technicians will need to be trained not only on machinery, but also on components that require computer and diagnostic skills.

While the promise of reduced maintenance costs will likely be borne after a full transition to a fully BEB fleet, during the transition period, BFT will require diesel technicians and train existing staff on the new technology. One potential strategy to manage lower workforce needs is through natural attrition tied to BFT's implementation schedule for transitioning to ZEBs. If that is not possible, deliberate reductions in maintenance staffing may result ahead of the 100% transition date based on the actual needs and experiences of the agency.

Finally, because a ZEB transition and implementation is an agencywide endeavor that also includes the need to actively consider utilities as a stakeholder and partner, an agencywide approach is required. Additionally, the union representing the bus operators and maintenance technicians should also be included due to the large role they will play in the success of the ZEB transition and implementation. Thus, it would be prudent for BFT to form a steering committee or task force composed of staff from each major functional department and union representation to help ensure the impact of ZEBs are considered for each. The task force should also name a leader who acts as a champion for the ZEB conversion within the agency and to external stakeholders. Communication will be critical during the transition to ensure customers are made aware of potential disruptions and changes to bus operations. ZEB conversion also offers an excellent marketing opportunity for BFT to promote its climate commitments.

13.0 POTENTIAL FUNDING SOURCES

As a clear cost driver for transit agencies, funding the ZEB transition will require external financial aid. Due to the long timeframe over which buses will be procured and infrastructure will be constructed, it is imperative that BFT constantly monitors existing funding and financing opportunities and is aware of when new sources are created. Additionally, as more transit agencies in the state and country consider ZEB transitions, new funding opportunities may occur. Below are major current programs available for ZEB transition in Table 20.

Table 20: Grants and potential funding options for ZEB transition

Fund/Grant	Level of government	Description	Available Funding/Applicability/Information	Average/ Example Award Amounts
Low or No Emission Program (Low-No Program)	Federal/FTA	Low-No provides competitive funding for the procurement of low or no emission vehicles, including the leasing or purchasing of vehicles and related supporting infrastructure. This has been an annual program under the FAST Act since FY2016 and is a subprogram of the Section 5339 Grants for Bus and Bus Facilities. There is a stipulation for a local match.	For FY 2022, FTA announced availability of over $1.1 billion for Low-No, funding. In FY 2021, the FTA awarded $182 million to 49 projects for the Low-No program.	Average: $3,169,674 Median: $3,017,280 In 2020, the Antelope Valley Transit Authority (AVTA) received over $6 million to assist in the purchase of ZEBs[10][11]
Buses and Bus Facilities Program (5339)	Federal/FTA	Grants applicable to rehabbing buses, purchase new buses, and invest and renovate related equipment and facilities for low or no emission vehicles or facilities. Requires a 20% local match.	In FY 2022, FTA announced availability of $372 million in Bus and Bus Facility grants.	Average: $4,503,500[12] [13] The JPA in Merced County ("The Bus") was awarded $2 million for ZEB electric buses and associated charging equipment in FY19.
Urbanized Area Formula Grants (5307)	Federal/FTA	5307 grant funding makes federal resources available to urbanized areas for transit capital and operating assistance. Eligible activities include capital investments in bus and bus-related activities such as replacement, overhaul and rebuilding of buses. The federal share is not to exceed 80% of the net project cost for capital expenditures. The federal share may be 90% of the cost of vehicle-related equipment attributable to compliance with the Clean Air Act.	Typically, the metropolitan planning organization (MPO) or another lead public agency is the direct recipient of these funds and distributes these to local transit agencies based on TIP allocation. Agencies can allocate these funds for the purchase of ZEBs.	The Alameda Contra Costa Transit District (AC Transit) has allocated $979,000 in 5307 funds in the MTC's 2021 Draft TIP to assist in the purchase of 10 ZEBs.
Better Utilizing Investments to Leverage Development (BUILD)	Federal/USDOT	Formerly TIGER, BUILD is a discretionary grant program aimed to support investment in infrastructure. BUILD funding supports planning and capital investments in roads, bridges, transit, rail, ports, and intermodal transportation. A local match is required.	FY 2022 provided $1.5 billion in BUILD grants, with a stipulation requiring 50% of funding for projects in rural areas.	Average: $16,891,781 Median: $20,000,000[14][15]

[10] Average and median 2020 award amounts. Award amounts for 2019 ranged from $356,000 to a maximum of $7,000,000
[11] https://www.transit.dot.gov/funding/grants/fiscal-year-2020-low-or-no-emission-low-no-bus-program-projects
[12] https://mtc.ca.gov/sites/default/files/_S4_Draft%202021%20Tip%20Publication%20Report-transit.pdf
[13] https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/5339_Bus_and_Bus_Facilities_Fact_Sheet.pdf
[14] https://www.transit.dot.gov/funding/grants/urbanized-area-formula-grants-5307#:~:text=Program%20Overview,and%20for%20transportation%2Drelated%20planning.
[15] https://www.transportation.gov/BUILDgrants, https://www.transportation.gov/sites/dot.gov/files/2020-09/BUILD%202020%20Fact%20Sheets-.pdf

Fund/Grant	Level of government	Description	Available Funding/Applicability/Information	Average/ Example Award Amounts
VW Environmental Mitigation Trust Funding	WA State	VW's settlement provides nearly $141 million for projects that maximize air quality improvements. Funds are allocated in cycles with the current cycle focused on electric fire apparatuses.	Projects that invest in replacing or repowering eligible vehicles with less-polluting, alternate fueled, or all-electric engines and charging infrastructure are eligible for funding. Current cycle funding opens October 16, 2022.	Amounts available vary based on funding cycle. Grant award limits vary by guidelines as well as amount of matching funds required. [16]
Green Transportation Capital	WA State	Funding for capital programs that will reduce the carbon intensity of Washington's transportation system. Transition to ZE technology including construction, capital investment, and planning activities.	A minimum of $12 million but up to $50 million in state funding per biennium. Applications are due September 29, 2022, for the current 2023-2025 period. Projects must be completed within the biennium. Transit agency must provide 20% matching funds.	Capital grants range from $500,000 to $3.6 million with most around $1.75 million. [17]
Clean Energy Fund (CEF)	WA State	CEF provides funding for installation and infrastructure upgrades to expand use of EVs.	Broken into two phases, phase one provides $970,000 of funds. Match can be provided by Federal funds, but State funds cannot be used to match. Charging infrastructure is reserved for phase two funding.	Minimum grant amount is $100,000 and can include staff time for project development/management as well as education and outreach. [18]

[16] Volkswagen enforcement action grants - Washington State Department of Ecology
[17] Green Transportation Capital | WSDOT (wa.gov)
[18] Electrification of Transportation - Washington State Department of Commerce

In December 2021, the FTA released a Dear Colleague letter outlining new requirements for Low-No and Bus and Bus Facility Grant Applications. The letter details the requirement for a Zero-Emission Fleet Transition plan in response to amendments in the statutory provisions for these programs as part of the Bipartisan Infrastructure Law. The FTA Zero-Emission Fleet Transition plan includes six major elements, presented in Table 21. Moving forward, to qualify for these funding opportunities, a transit agency must include a transition plan with these elements.

Table 21: FTA Zero-Emission Fleet Transition Plan requirements

Element	Description
1: Long-Term Fleet Plan and Application Request	Demonstrate a long-term fleet management plan with a strategy for how the applicant intends to use the current application and future acquisitions.
2: Current and Future Resources to Meet Transition	Address the availability of current and future resources to meet costs for the transition and implementation
3: Policy and Legislative Impacts	Consider policy and legislation impacting relevant technologies.
4: Facility Evaluation and Needs for Technology Transition	Include an evaluation of existing and future facilities and their relationship to the technology transition.
5: Utility Partnership	Describe the partnership of the applicant with the utility or alternative fuel provider.
6: Workforce Training and Transition	Examine the impact of the transition on the applicant’s current workforce by identifying skill gaps, training needs, and retraining needs of the exiting workers of the applicant to operate and maintain ZEVs and related infrastructure and avoid displacement of the existing workforce.

14.0 GHG IMPACTS

Based on the ZEVDecide modeling of greenhouse gas emissions (GHG), BFT's diesel/gasoline fleet emits 3,800 tons of GHGs in a year.[19] In contrast, the future BEB fleet will only emit close to 750 tons annually; while tailpipe emissions of BEBs is nil, residual GHGs results from the carbon-intensity of the electric grid. As modeled, a completely BEB fleet can reduce BFT's GHG footprint by ~3,100 tons annually. Table 22 shows the annual emissions of the fleet by service type and Table 23 presents a summary and the average emissions per vehicle.

Table 22: Annual Emission in Tons of CO_2 per year for BFT's fleet by service type

	Zero Emissions		Diesel/Gasoline	
	Commuter and Local Fleet	**Demand Response Fleet**	**Commuter and Local**	**Demand Response**
Fleet tailpipe emissions (ton CO_2/year)	-	-	2,209	178
Upstream emissions (ton CO_2/year)	658	96	798	652
Total Ton CO_2/year	**658**	**96**	**3,007**	**830**

Table 23: Summary of Annual Emissions for BFT's fleet

	Fleet Emissions (Ton CO_2/year)	Emissions per Vehicle (Ton CO_2/vehicle/year)
BEB fleet	754	41
Diesel/Gasoline Fleet	3,837	203
Difference	**3,083**	**162**
	80%	80%

On average, implementing BEBs reduces the annual emissions by 80% when compared to the conventional diesel fleet.

[19] All GHG calculations are presented in tons (not metric tons) of CO_2 equivalent, which is calculated using the short-term 20-year global warming potential of CO_2, methane, black carbon, and particulate matter.

Using the EPA GHG equivalent calculator[20], we used the annual emissions that will be displaced by the BEB fleet to create relative comparisons to the benefits. As presented in Figure 38, implementing a ZEB fleet will eliminate emissions equivalent to removing 600 passenger vehicles per year or reducing emissions of 340 households in a year.

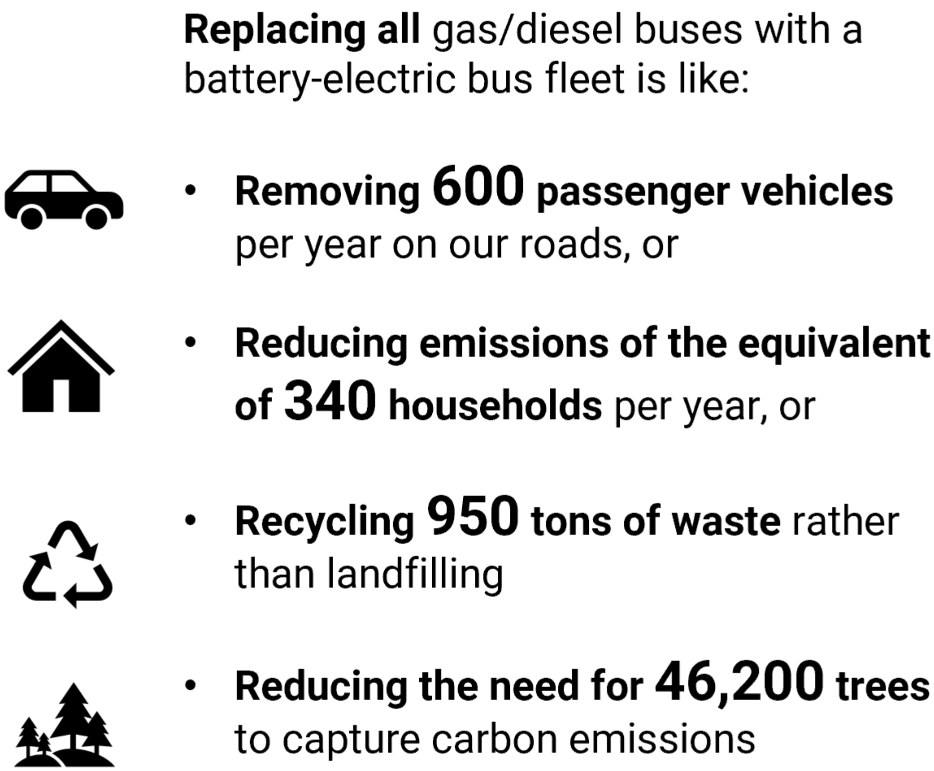


Figure 38: Equivalent benefits of implementing a BEB fleet at BFT.

[20] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

15.0 CONSIDERATIONS FOR HYDROGEN BUSES

As the route modeling demonstrated, BFT's blocks and operating profile are mainly amenable to electrification with hydrogen FCEBs (96% of blocks), with some minor alterations to vehicle scheduling, as well as potential midday refueling. Nonetheless, as of 2021, only 2 FCEBs are in operation in Washington[21] and the hydrogen supply chain in Washington is still nascent. It is worth noting that Intercity Transit (IT) in Olympia, WA has initiated modifications to their main facility in the form of a future hydrogen trench to accommodate a hydrogen fleet in the future. While IT hasn't decided upon a fleet technology for their zero-emission transition, they have anticipated that hydrogen will play an important role and therefore have started to incorporate modifications to their upgraded facility accordingly.

To deploy FCEBs, BFT can use the information from the modeling to estimate fuel consumption and inform the volume of hydrogen fuel required depending on the fleet size, bus types, and duty cycles. Stantec anticipates a daily demand of close to 2,000 kg/day of hydrogen that would translate to a hydrogen station with at least 8 MT of onsite capacity. Furthermore, BFT will need to procure FCEBs, which exhibit a price premium over BEBs, as shown below based on information from the state's procurement documents for ZEBs:

Table 24: Summary of Annual Emissions for BFT's fleet

OEM	Bus length	BEB Cost	FCEB Cost	Difference (FCEB – BEB)
New Flyer	40-ft	$860,000 525 kWh	$1,087,000 35 kg	$227,000
ElDorado National	40-ft	NA	$1,195,000 50 kg	NA

Currently in North America, FCEBs are limited to New Flyer and ElDorado National manufactured vehicles, but as demand increases, it is likely that other entrants will appear.

A key advantage to FCEBs is the operating range of 300+ miles that more closely mimics diesel buses that BFT is accustomed to, which helps hydrogen technology replace diesel buses in a one-to-one manner. Moreover, the refueling process of a FCEB is similar to refueling diesel or natural gas buses; a hose or dispenser is connected to the fuel gauge and after 8 to 10 minutes, the tank is full. The SAE standard J2601-2 for hydrogen dispensers references an upper flow limit for hydrogen dispensing of 7.2 kg/minute.

Based on current experience, transit agencies which have deployed FCEBs in California have largely taken the strategy of building out a hydrogen fueling facility in their bus yard that includes a liquid hydrogen storage tank that is replenished by trucked-in liquid hydrogen. This equipment, including the installation of gas leak detection systems is expensive—usually north of $5 million. The cost for the hydrogen infrastructure is a fixed cost, in that this $5+ million investment can be used to fuel and operate

[21] https://calstart.org/wp-content/uploads/2022/01/2021-ZIO-ZEB-Final-Report_1.3.21.pdf

a fleet of up to +60 buses, depending on the size of the hydrogen storage tank (Figure 39). This means that an investment in hydrogen fueling infrastructure makes more sense at a larger scale—the more FCEBs BFT could deploy, the more cost effective the investment in a hydrogen fueling station could be.

Figure 39: Liquid hydrogen storage tank and vaporizers as part of Orange County's hydrogen fuelling infrastructure.

The hydrogen dispenser typically includes a nozzle that connects to the vehicle and a user interface (the controls at the dispenser) for initiating fueling (including emergency shutdown controls). The dispenser is usually the only part of the station with which the end users will interact. Details of the connection device (nozzle) are defined by international standards such as ISO 17268:2012 and SAE J2600. The hydrogen refueling process is also standardized with SAE J2601-2. This standardization in hydrogen refueling ensures interoperability and vehicle compatibility—i.e., any hydrogen-fueled bus designed to comply with the standards can refuel at any station also designed according to the standards.

Figure 40: Hydrogen fuelling dispenser, Orange County, California.

The size and configuration of the hydrogen station depends on the number of buses that need to be filled overnight (usually in a seven-hour shift), and the average hydrogen dispensed to each bus (between 30 to 60 kg per bus). Therefore, the daily hydrogen demand and active fleet size will determine the proper configuration of the station, reflected in total number of hydrogen pumps and number of dispensers (or refueling islands).

Hydrogen can be acquired through a variety of methods, including the following:

- A tube trailer used to supply gaseous hydrogen (only applicable for light-duty fleets or small transit fleets)
- A tube trailer used to supply liquid hydrogen
- On-site generation of hydrogen using Steam Methane Reformation (SMR)
- On-site generation of hydrogen using water electrolysis (which can be powered by grid electricity or using renewable electricity, such as electricity from solar panels)

The method for hydrogen procurement and fueling will depend on several factors, including reliable access to affordable natural gas, and access to water and affordable electricity, the ingredients for hydrogen production. Centralized SMR production would be favored in regions with access to methane/natural gas and other raw materials.

Another key factor is the FCEB fleet size and vehicle assignment mileage for a given transit agency. Smaller FCEB operations (<5 FCEBs) tend to favor gaseous hydrogen delivered from a tube trailer due to its lower upfront capital investment requirements, while larger operations (>50 FCEBs) favor liquid hydrogen delivery due to the greater volumes and better rates on a cost-per-mile basis. Larger operations (>300 vehicles) with higher capital expense budgets also favor on-site generation of hydrogen using SMR or electrolysis, to achieve further operating cost savings through the elimination of delivery charges.

Electricity-abundant regions favor electrolysis while hydrogen-abundant jurisdictions favor the delivery of gaseous or liquid hydrogen. Jurisdictions without abundant electricity and hydrogen tend to gravitate to on-site generation using SMR, though this is typically only if they have abundant natural gas, which gets converted to hydrogen in the SMR process.

It should be noted that the four methods of acquiring hydrogen are not mutually exclusive, and some regions or agencies may acquire their hydrogen supply through a combination of these methods.

To date, liquid hydrogen delivery and storage is generally the most common model for transit agencies, followed by on-site generation of hydrogen via SMR. As more agencies deploy larger numbers of FCEBs, the model of hydrogen supply may change. Table 25 is a summary from a Ballard report showing the suitability of different hydrogen sources.

Table 25: Ballard Report of Suitability for Different Hydrogen Sources

	Compressed hydrogen gas	**Liquid hydrogen**	**Local SMR**	**Local electrolysis**
Overall	Good for smaller volumes	Good for large volumes	Good for large volumes	Good for large volumes
Distribution Costs	High; price impacted by location from supply	Nominal; range flexibility	Nominal	Nominal
Price volatility	Dependent on fuel prices; available bulk discounts	Dependent on fuel prices; available bulk discounts	Dependent on maintenance and fuel costs	Dependent on maintenance and electricity
Infrastructure costs	Lower	Higher	Depends on production capacity	Depends on production capacity
Carbon emission reductions	N/A	N/A	Renewable biogas available at higher costs	Clean hydropower available or infrastructure can be installed for local solar or wind electricity generation

Hydrogen fuel can be produced in several ways, and different methods use differing amounts of carbon to create the hydrogen. Hydrogen production can be categorized as gray, blue, or green:

- **Gray** hydrogen is created using fossil fuels.
- Hydrogen is labeled **blue** whenever the carbon generated during production is captured and stored underground through industrial carbon capture and storage (CCS). Therefore, blue hydrogen is a "low carbon" solution as 5-15% of the generated carbon cannot be captured.
- **Green** hydrogen is produced without any carbon, is clean and 100% renewable.

Figure 41 summarizes the process and source for each hydrogen type.

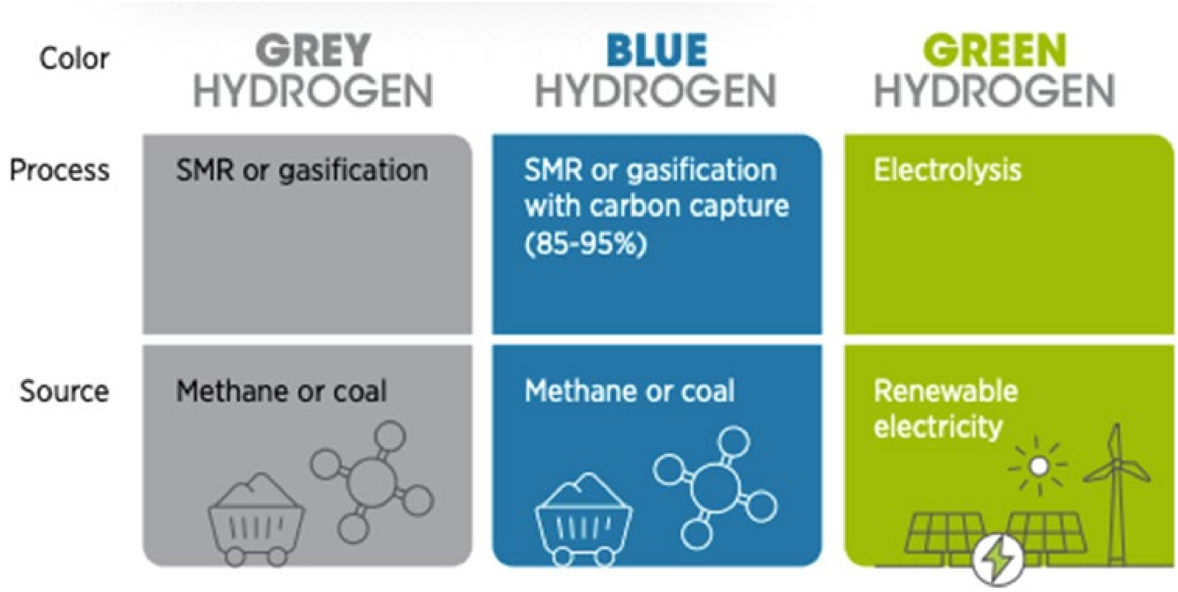


Figure 41: Hydrogen classification based on carbon intensity

Upstream processes and associated economics related to the production of hydrogen are evolving rapidly. The decarbonization of hydrogen is gaining much focus from the gas industry. It is important to understand the impact of scale for onsite generation as well as for carbon capture, which are used to generate clean (green) hydrogen and blue hydrogen, respectively. Storage of captured carbon dioxide will also have to be considered on a local scale. Green hydrogen production is expected to benefit from economies of scale and become more affordable as processing techniques improve.

In addition to the carbon footprint tied to hydrogen production itself, there are varying levels of GHG emissions depending on the supply line used and distances that hydrogen would need to travel before reaching the final user. For example, delivery of hydrogen with a diesel-powered truck would have a larger GHG impact than supply through a fuel pipeline.

Ideally, to maximize the environmental benefits of FCEBs, green hydrogen is preferred to maximize the reduction of GHGs; minimizing the distance that the hydrogen needs to travel is preferred as well. Nonetheless, access to green hydrogen may be limited in certain markets, so it will be important in future steps that BFT understand the types of hydrogen fuel available for purchase because producing hydrogen on-site can be an expensive endeavor.

And while BEBs and FCEBs contain some overlapping systems that operators and mechanics will need to be trained on, some specific training and courses for FCEBs are outline in Table 26 generated from information provided by OEMs for California's statewide ZEB contracts

Table 26: OEM recommendations from the California ZEB contract procurement

Training Type	Course	Sessions	Session Hours
Operator	Drive training	4	4
	Overall vehicle/system orientation	20	2
Maintenance/Technician	Preventative maintenance	4	8
	Electrical/electronic	6	8
	Multiplex	4	3x8 days
	HVAC	4	4
	Brakes	4	4
	Energy storage system, lithium-ion battery and energy management hardware and software training	6	8
	Electric drive/transmission	6	8
	H2 system – fuel cell engine	6	8
	H2 fuel system	4	8
	H2 detection and fire suppression systems	4	8
	H2 cooling system package	6	4

16.0 PHASING AND IMPLEMENTATION

Table 27 provides an overview of the proposed phasing plan for BFT's ZEB rollout strategy. See Table 12 for more details regarding the fleet replacement schedule. Note that these tables demonstrate what a 100% transition *could* look like. BFT has set a goal of at least 25% ZEBs by 2040, that will strongly depend on funding availability, vehicle turnover, service changes, and other factors. Nonetheless, BFT can use this plan as a framework and update it as it transitions to alternative fuels.

Table 27: ZEB implementation phasing plan, FY2023-2040

Year	Charging equipment installation	Fixed-Route ZEB Fleet Procurements	Training: operators, maintenance staff, technicians	Training - other	Capital Expenses	Operating Expenses	Total expenses (2022$)
FY2023	10 chargers 20 plug-ins	0 30-ft 0 35-ft 4 40-ft	OEM training	OEM training for all other staff	$8,603,000	$5,266,000	$13,869,000
FY2024		0 30-ft 0 35-ft 4 40-ft	Annual refreshers	Local fire and emergency response department introduction to new technology	$3,469,000	$4,870,000	$8,339,000
FY2025		0 30-ft 5 35-ft 0 40-ft	OEM training	No activity	$3,656,000	$4,419,000	$8,075,000
FY2026		0 30-ft 0 35-ft 5 40-ft	Annual refreshers	Local fire and emergency response department introduction to new technology	$3,814,000	$4,028,000	$7,842,000
FY2027	10 chargers 20 plug-ins	0 30-ft 0 35-ft 7 40-ft	OEM training	OEM training for all other staff	$10,149,000	$3,741,000	$13,890,000
FY2028		0 30-ft 0 35-ft 5 40-ft	Annual refreshers	Local fire and emergency response department introduction to new technology	$3,372,000	$3,403,000	$6,775,000

Year	Charging equipment installation	Fixed-Route ZEB Fleet Procurements	Training: operators, maintenance staff, technicians	Training - other	Capital Expenses	Operating Expenses	Total expenses (2022$)
FY2029		0 30-ft 0 35-ft 5 40-ft	OEM training	No activity	$5,488,000	$3,190,000	$8,678,000
FY2030		0 30-ft 0 35-ft 6 40-ft	Annual refreshers	Local fire and emergency response department introduction to new technology	$4,042,000	$2,970,000	$7,012,000
FY2031	6 chargers 12 plug-ins	0 30-ft 0 35-ft 6 40-ft	OEM training	OEM training for all other staff	$6,572,000	$2,821,000	$9,393,000
FY2032		0 30-ft 0 35 -ft 6 40-ft	Annual refreshers	Local fire and emergency response department introduction to new technology	$3,670,000	$2,621,000	$6,291,000
FY2033	14 chargers 28 plug-ins	0 30-ft 0 35-ft 5 40-ft	OEM training	No activity	$6,573,000	$2,379,000	$8,952,000
FY2034		0 30-ft 3 35-ft 0 40-ft	Annual refreshers	Local fire and emergency response department training on new technology	$1,657,000	$2,172,000	$3,829,000
FY2035		0 30-ft 0 35-ft 7 40-ft	OEM training	OEM training for all other staff	$3,521,000	$1,895,000	$5,416,000
FY2036		0 30-ft 6 35-ft 0 40-ft	Annual refreshers	Local fire and emergency response department training on new technology	$2,699,000	$1,677,000	$4,376,000

Year	Charging equipment installation	Fixed-Route ZEB Fleet Procurements	Training: operators, maintenance staff, technicians	Training - other	Capital Expenses	Operating Expenses	Total expenses (2022$)
FY2037		0 30-ft 6 35-ft 4 40-ft	OEM training	No activity	$4,213,000	$1,481,000	$5,694,000
FY2038		0 30-ft 0 35-ft 4 40-ft	Annual refreshers	Local fire and emergency response department training on new technology	$1,791,000	$1,383,000	$3,174,000
FY2039		0 30-ft 5 35-ft 0 40-ft	OEM training	OEM training for all other staff	$1,871,000	$1,291,000	$3,162,000
FY2040		0 30-ft 0 35-ft 5 40-ft	Annual refreshers	Local fire and emergency response department training on new technology	$1,846,000	$1,206,000	$3,052,000

APPENDICES

APPENDIX A: FINANCIAL MODELING INPUTS AND ASSUMPTIONS

Table 28 presents a description as well as the sources for the cost inputs (in 2022$) of the Base Case and the ZEB Case.

Table 28: Summary of cost inputs

Main Category	Item	Description	Inputs for Base Case	Inputs for ZEB Case	Sources and comments
Fleet Acquisition	Bus purchase price	Purchase price of a bus/vehicle inclusive of options and taxes and extended warranty.	Diesel 40-ft: $600,000 Diesel 35-ft: $578,000	BEB 40-ft: $992,008 BEB 35-ft: $884,008	Base Case: BFT Transit Development Plan and based on most recent purchase prices from 2018 adjusted for inflation to 2022$. ZEB Case: Washington State contract for transit buses (Proterra) Values are in 2022$ and adjusted over time based on price trendlines from the California Air Resource Board.
Fleet Refurbishment	Mid-life rehabs	Any heavy mid-life work needed to achieve the useful life minimum benchmark.	BFT performs midlife overhauls at the midlife of their current diesel vehicles based on mileage. Because this is based on mileage and hard to pin down in years, midlife overhauls of the diesel fleet was not included in the financial model.	$400/kWh at 7 years for battery replacement.	Base Case: BFT ZEB Case: OEM information

Main Category	Item	Description	Inputs for Base Case	Inputs for ZEB Case	Sources and comments
Infrastructure and Facility Modifications	Infrastructure Modification Costs	Includes equipment, installation, testing, civil and electrical work, as well as contractor's fees and escalation factors. Includes backup generator ~~for hydrogen fueling equipment~~.	N/A	Main facility: $20,956,086 Three Rivers Transit Center: $2,896,569 22nd Street Transit Center: $1,958,783 Knight Street Transit Center: $2,048,759	Engineer's cost estimate.
Operating	Vehicle fuel	Cost of fuel commodity for revenue vehicles.	Diesel: $2.43 per gallon	Electricity: $0.083 per kWh	Base Case: BFT ZEB Case: the average price for electricity in $/kWh was calculated based on the current rates for each PUD by projecting the annual energy use at the main facility and at the three transit centers to then obtain an average in $/kWh.
Maintenance	Vehicle maintenance costs	Maintenance costs (per mile) inclusive of labor and parts for scheduled and unscheduled maintenance.	Diesel: $1.37 per mile	BEBs: $1.03 per mile	Base Case: NTD 2020 Operating Expenses Detailed sheet, adjusted to 2022$ ZEB Case: Based on industry research demonstrating comparative maintenance costs per mile[22]

[22] https://www.nrel.gov/docs/fy21osti/78078.pdf, https://www.nrel.gov/docs/fy21osti/78250.pdf

APPENDIX B: PDF OF SITE PLANS

APPENDIX C: COST ESTIMATES

APPENDIX D: SOLAR ANALYSIS

Transit
BEN FRANKLIN TRANSIT

Agency Performance

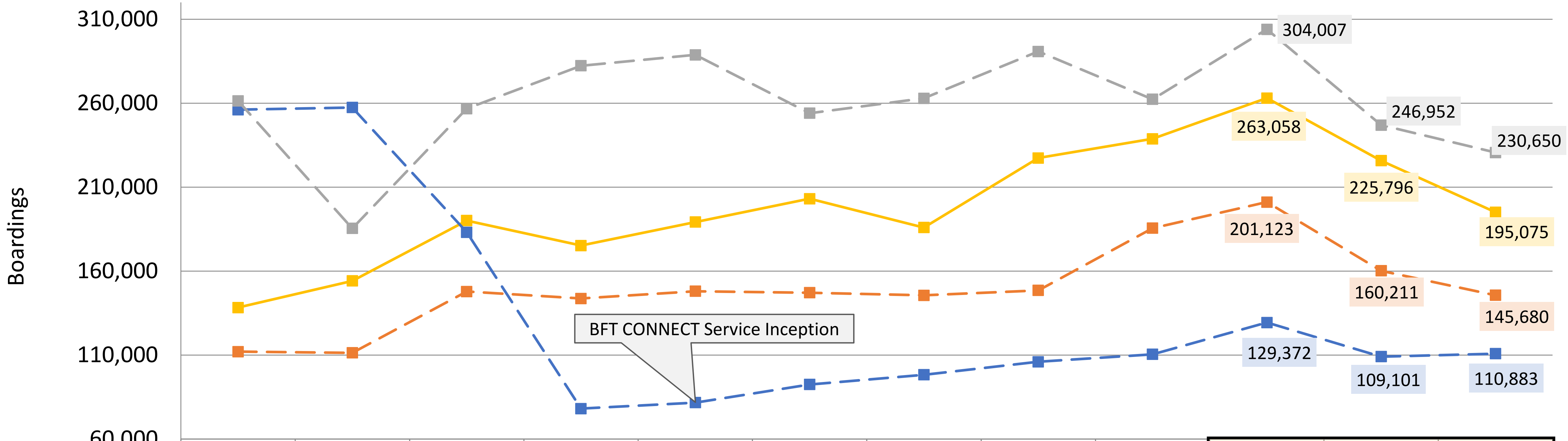
Fourth Quarter 2022

Q4 2022 Ridership

Annual Total System Boardings

Q4 Highlight:
Continued signs of recovery

2022 YE	2021 YE	2020 YE	2019 YE
2,386,376	1,797,039	1,613,413	3,126,689

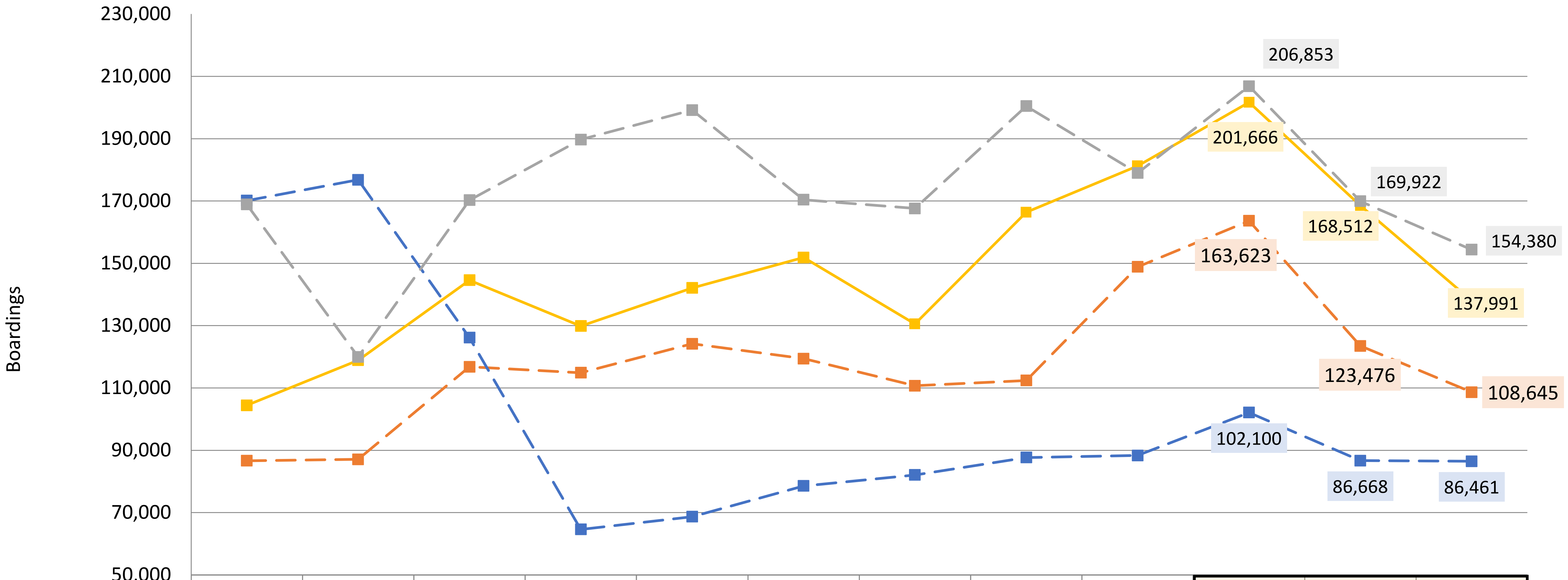


	Jan	Feb	Mar	April	May	June	Jul	Aug	Sep	Oct	Nov	Dec
		Q1			Q2			Q3			Q4	
2022	138,333	154,184	190,141	175,230	189,246	203,144	185,972	227,371	238,827	263,058	225,796	195,075
2021	112,066	111,372	147,871	143,744	148,038	147,162	145,628	148,537	185,607	201,123	160,211	145,680
2020	256,141	257,470	183,179	78,155	81,730	92,551	98,288	106,020	110,523	129,372	109,101	110,883
2019	261,440	185,465	256,789	282,348	288,832	254,066	262,936	290,834	262,370	304,007	246,952	230,650

Ridership Trends: Q4 Δ 2021/2022 = 34.9%

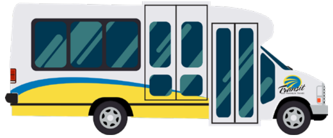
Fixed Route Q4 Performance

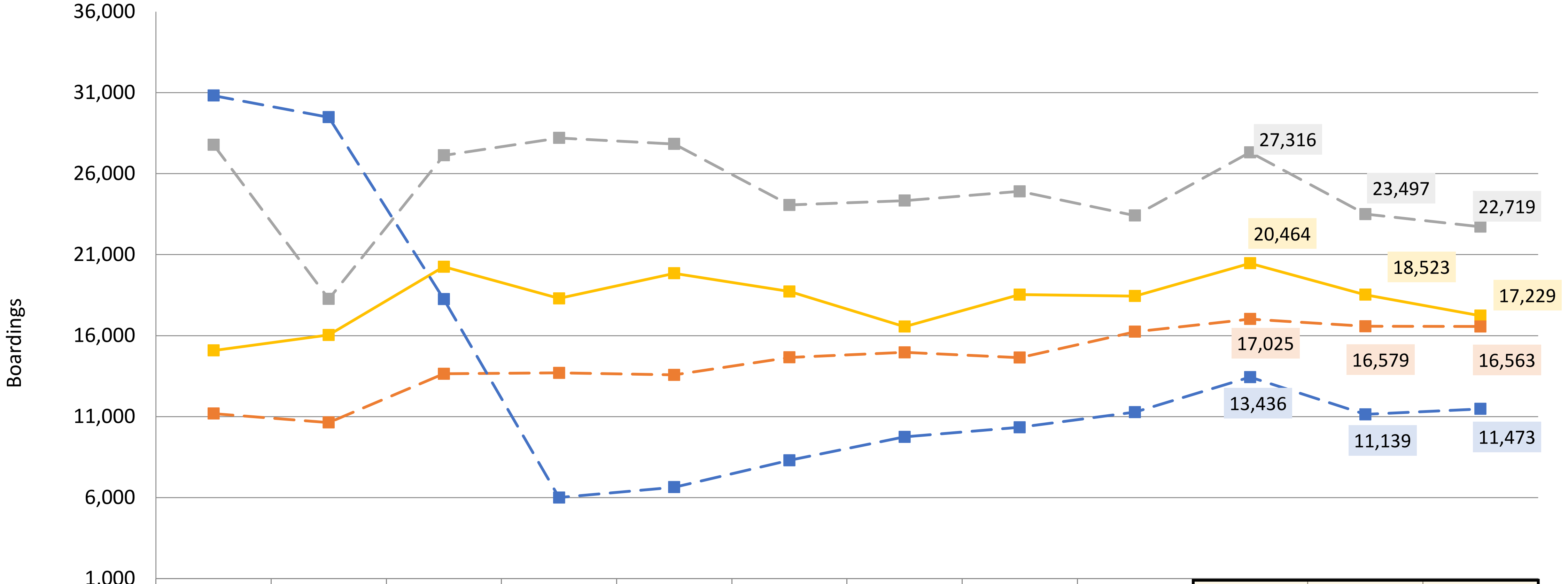
Q4 Highlight:
Continued signs of recovery



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Q1			Q2			Q3			Q4	
2022	104,416	118,875	144,570	129,878	142,101	151,851	130,523	166,361	181,264	201,666	168,512	137,991
2021	86,633	87,086	116,794	114,883	124,180	119,399	110,689	112,380	148,843	163,623	123,476	108,645
2020	170,146	176,786	126,153	64,607	68,678	78,545	82,066	87,655	88,312	102,100	86,668	86,461
2019	168,881	119,954	170,285	189,709	199,166	170,420	167,602	200,436	178,964	206,853	169,922	154,380

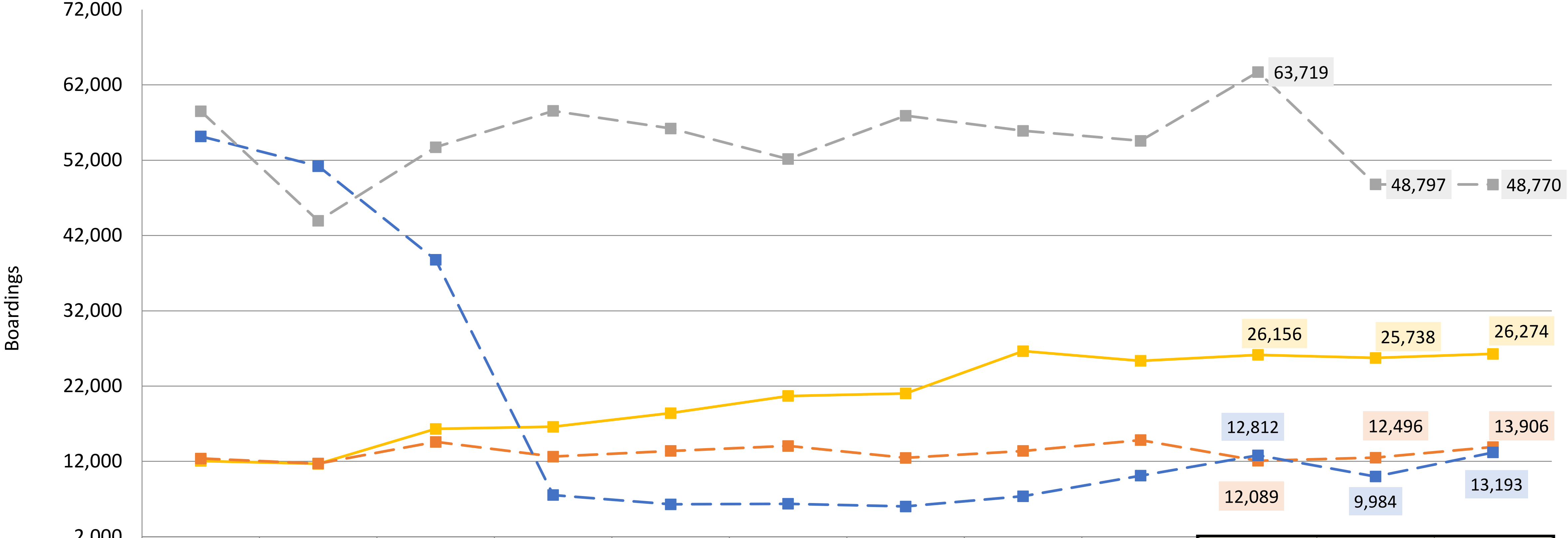
Dial-a-Ride Q4 Performance





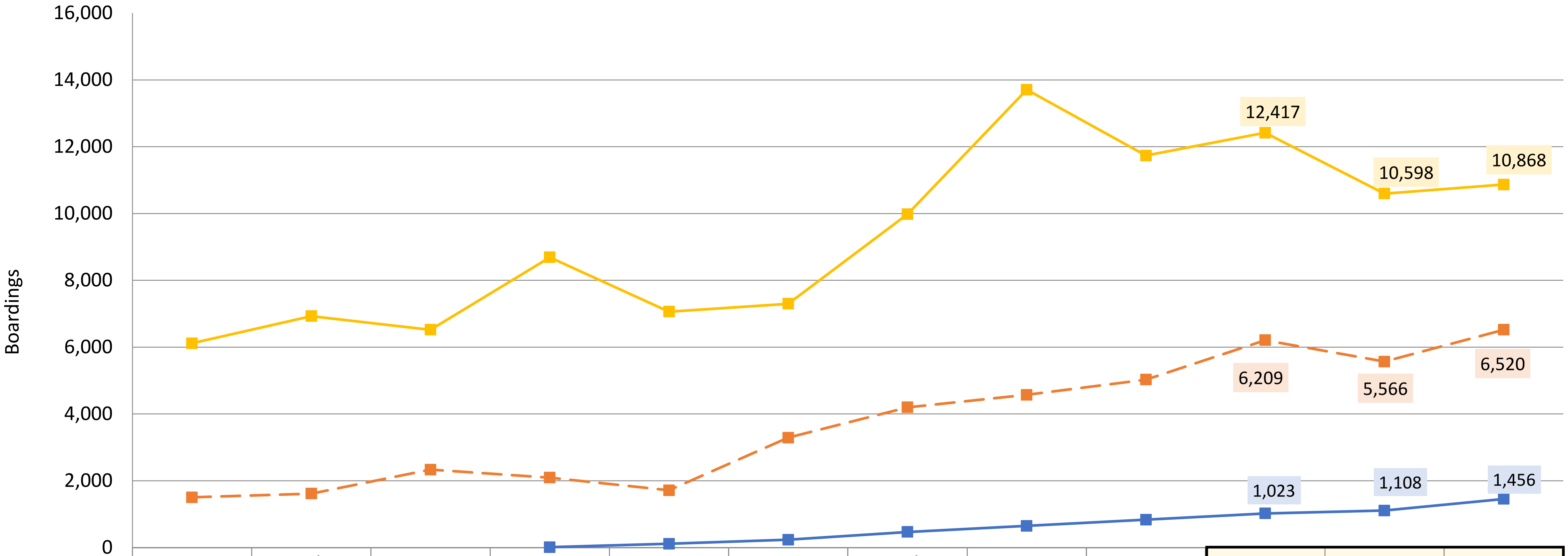
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Q1			Q2			Q3			Q4	
2022	15,079	16,036	20,251	18,295	19,842	18,724	16,558	18,528	18,439	20,464	18,523	17,229
2021	11,189	10,634	13,646	13,697	13,575	14,655	14,965	14,639	16,240	17,025	16,579	16,563
2020	30,820	29,481	18,248	6,003	6,646	8,301	9,747	10,343	11,276	13,436	11,139	11,473
2019	27,781	18,262	27,126	28,202	27,831	24,064	24,336	24,905	23,409	27,316	23,497	22,719

Vanpool Q4 Performance



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Q1			Q2			Q3			Q4	
2022	12,058	11,675	16,315	16,603	18,412	20,686	21,028	26,649	25,364	26,156	25,738	26,274
2021	12,377	11,722	14,595	12,631	13,380	14,056	12,461	13,392	14,826	12,089	12,496	13,906
2020	55,175	51,203	38,778	7,533	6,291	6,361	6,008	7,373	10,103	12,812	9,984	13,193
2019	58,515	43,953	53,724	58,550	56,219	52,154	57,923	55,906	54,573	63,719	48,797	48,770

BFT CONNECT Q4 Performance



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
		Q1			Q2			Q3			Q4	
2022	6,115	6,929	6,522	8,688	7,064	7,301	9,981	13,706	11,735	12,417	10,598	10,868
2021	1,503	1,617	2,333	2,093	1,714	3,290	4,200	4,571	5,030	6,209	5,566	6,520
2020				12	115	235	467	649	834	1,023	1,108	1,456

Q4 Youth Ride Free Performance (October - December)

EVENTS

October

- Riverfest
- Coats for Kids
- Senior Times Expo
- Cane Quest
- Trunk or Treat

November

- Veterans Parade
- Coats for Kids
- Second Harvest Turkey Drive

December

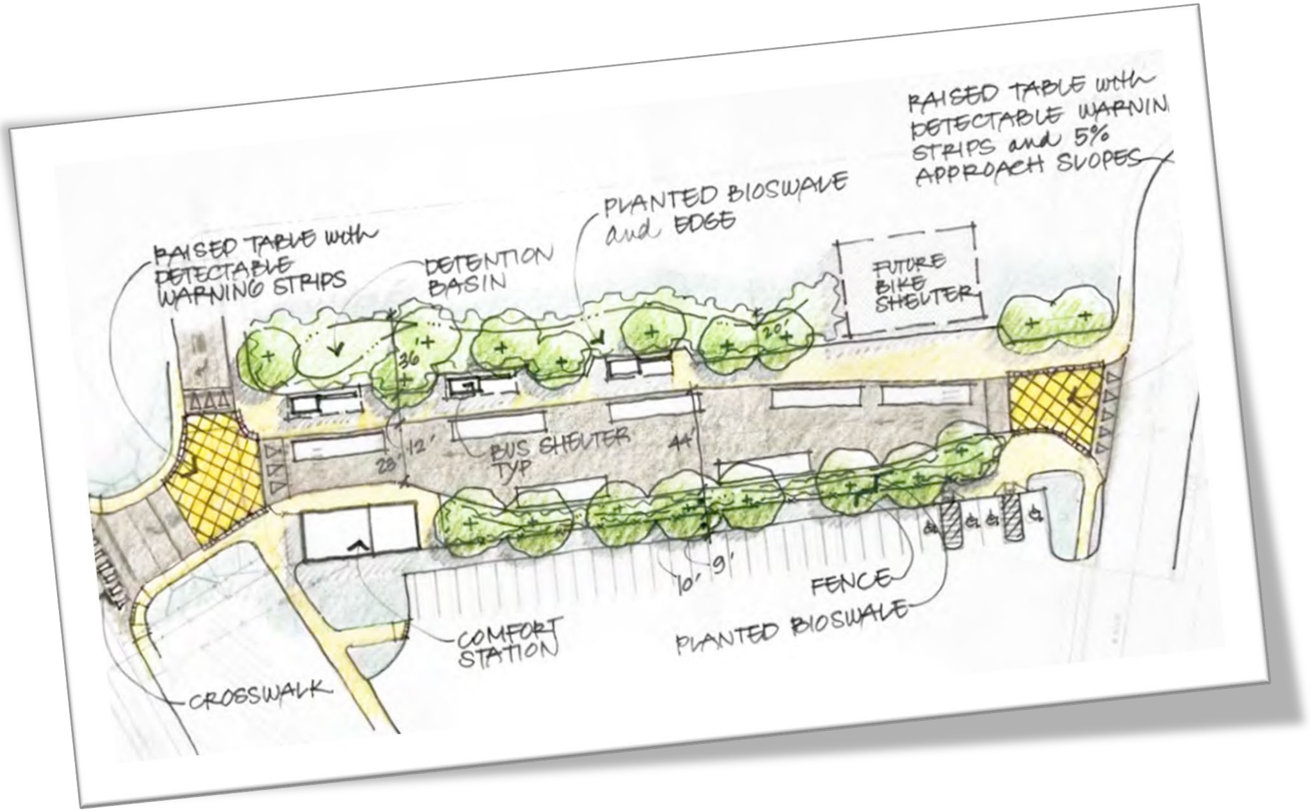
- Coats for Kids
- Second Harvest Holiday Boxes
- Fill the Toy Trolley
  (Partnership with Townsquare Media and Ranch & Home)
- Cable Bridge Run

Construction Update

Operations Building Update

- Move complete
- Fowler General Construction selected
- $9.9 million construction costs
- Federal & local funding
- Construction starting in Q1 2023
- Estimated completion in Q2 2024
- Electrical gear modification and delay – long lead times

Queensgate Transit Hub Update



- Located adjacent to Tulip Lane Park & Ride
- GAME Construction selected
- $3.2 million construction costs
- State & local funding
- Construction starting in February
- Estimated completion in Q2 2024

Additional Board Information February 2023

1. Executive Committee Meeting Minutes of February 2, 2023
2. 90-Day Procurement Outlook as of January 25, 2023
3. Financial Report through December 2022

EXECUTIVE COMMITTEE MEETING
Thursday, February 2, 2023 – 4 p.m.
Ben Franklin Transit – GM Conference Room
1000 Columbia Park Trail, Richland, Washington

Notice: Meeting attendance options included in person and virtual via Zoom

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M I N U T E S

Committee Members Present: Will McKay, Chair; Steve Becken, David Sandretto
Legal Counsel: Jeremy Bishop
BFT Staff: Rachelle Glazier, Janet Brett, Chad Crouch, Tom McCormick, Rob Orvis, Mike Roberts, Joshua Rosas, Kevin Sliger

1. **Convene Committee Meeting**

   Chair Will McKay convened the meeting at 4:00 p.m.

Proposed Board Agenda Action Item

2. **Resolution XX-2023 Authorizing the General Manager to Declare Old and Failed Information Technology Items as Surplus and Dispose of per Resolution 62-2014** - Mike Roberts, Information Technology Manager

   Information Technology Manager Mike Roberts presented a resolution for Board approval requesting authorization to declare old and failed information technology items as surplus and dispose of them per Resolution 62-2014. Committee members asked that this item be moved to the Board meeting Consent Agenda.

Proposed Board Agenda Informational/Discussion Items

3. **Informational Report on Fleet Transition** – Joshua Rosas, Senior Manager of Fleet & Facilities Maintenance

   Senior Manager of Fleet & Facilities Maintenance Joshua Rosas presented a Fleet Strategy Final Report prepared by Stantec, Inc. for Board information. Committee members asked that this item be moved to the Board agenda as an informational/discussion item for full Board input and questions.

4. **Fourth Quarter 2022 Performance Report** – Chief Planning & Development Officer Kevin Sliger presented the Fourth Quarter 2022 Performance Report for Board information. Committee members requested this be moved to the Board agenda for information.

<u>Additional Documents in Executive Committee Packet</u>

5. Notification of Upcoming Bids and Requests for Proposals

Senior Manager of Procurement Rob Orvis presented the monthly report on upcoming procurement activities.

6. Financial Report

General Manager Rachelle Glazier reviewed the November Sales Tax Comparison Report with committee members.

7. Other

BFT Legal Counsel Jeremy Bishop advised Board members that the current bylaws would support the addition of an Executive Committee, so there is no need to revise them now, unless the Board chose to do so. Board members agreed to wait until there are other items in the bylaws that require revision and make all of the changes at once.

Ms. Glazier explained to Board members present that she would like to adjust the pay grade of a current employee to the next quartile of his salary band to encourage him to remain at BFT despite receiving other employment offers. She asked how they would like her to proceed—if this information should be presented in an executive session for full Board consideration, or how they would like it handled. Board members present agreed it would be within the purview of the General Manager to make this adjustment, and they did not have an issue with a change to a salary within the same salary band.

Chief Planning & Development Officer Kevin Sliger reported to Board members that Route 64 will be modified to include service to the Lakeview community beginning in March and to Amazon later in the year, which is a slight modification from the published Annual Service Plan.

8. Adjourn

The meeting adjourned at 4:51 p.m.

Next Executive Committee Meeting – Thursday, March 2, 2023, at 4 p.m.

Procurement Outlook - 90 Day
Invitation for Bids / Request for Proposals

As of: 1/25/2023	Budget	Estimated Cost	Contract Term	Type IFB/RFP	Estimated Release Date	Estimated Award Date	Executive Board Committee
In Progress							
Color Code: Yellow - In Process							
Replacement of Chassis Wash Lift (A & E firm is reviewing and developing specifications)	Capital	$450,000	6 Months	IFB	3/15/2023	4/15/2023	X
February							
Color Code: Green - Recommendation for Award							
March							
Color Code: Grey - Future Procurement Awards							
Resolution to Extend - Contract with Via to Operate CONNECT On-Demand Services	Operating	$6,000,000	2 Years	NA	NA	Na	X
Resolution to Award - Bus Stop & Sidewalk Improvement Contract (Pending Grant Approval)	Capital	$2,500,000	2 Years	IFB	2/10/2023	3/20/2023	X
April							
Authorization to Extend - Columbia Basin College Comprehensive Transportation Bus Ride Program Agreement #893 for One Year	Operating	TBD	1 Year	NA	NA	NA	X
Authorization to Award - Fixed Route Service Analysis	Operating	$175,000	5 Years	RFP	2/20/2023	4/25/2023	X

Preliminary Financial Report Through December 2022

Preliminary Financial Performance Overview - YTD Cumulative Totals

Revenue & Expenses

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Revenue												
YTD Budget	$ 4,327,618	$ 8,550,874	$ 13,229,271	$ 17,808,198	$ 22,753,368	$ 27,902,123	$ 32,869,772	$ 37,729,747	$ 42,802,029	$ 47,631,181	$ 52,511,604	$ 57,786,200
YTD Actual	4,258,209	8,230,467	12,456,266	17,693,655	22,889,008	28,183,721	32,890,640	37,732,598	42,670,260	47,700,759	52,291,484	55,762,867
Variance - B/(W)	(69,409)	(320,407)	(773,005)	(114,543)	135,640	281,598	20,868	2,851	(131,769)	69,578	(220,120)	(2,023,333)
Percentage	98%	96%	94%	99%	101%	101%	100%	100%	100%	100%	100%	96%
Expenses - Operating												
YTD Budget	$ 3,722,381	$ 7,444,762	$ 11,167,143	$ 14,889,523	$ 18,611,904	$ 22,334,285	$ 26,056,666	$ 29,779,047	$ 33,501,428	$ 37,223,808	$ 40,946,189	$ 44,668,570
YTD Actual	2,933,852	5,819,067	8,819,333	11,902,179	15,146,439	18,464,469	21,762,055	25,594,816	28,573,022	31,842,283	35,034,398	38,271,117
Variance - B/(W)	788,529	1,625,695	2,347,809	2,987,344	3,465,465	3,869,816	4,294,611	4,184,230	4,928,406	5,381,526	5,911,791	6,397,453
Percentage	79%	78%	79%	80%	81%	83%	84%	86%	85%	86%	86%	86%
Expenses - Admin												
YTD Budget	$ 1,093,136	$ 2,186,272	$ 3,279,408	$ 4,372,543	$ 5,465,679	$ 6,558,815	$ 7,651,951	$ 8,745,087	$ 9,838,223	$ 10,931,358	$ 12,024,494	$ 13,117,630
YTD Actual	809,704	1,660,478	2,632,533	3,517,994	4,434,003	5,381,889	6,104,422	7,090,763	7,909,803	8,666,877	9,436,590	10,445,664
Variance - B/(W)	283,432	525,794	646,874	854,550	1,031,676	1,176,926	1,547,528	1,654,323	1,928,420	2,264,482	2,587,904	2,671,966
Percentage	74%	76%	80%	80%	81%	82%	80%	81%	80%	79%	78%	80%

Cost Per Mile

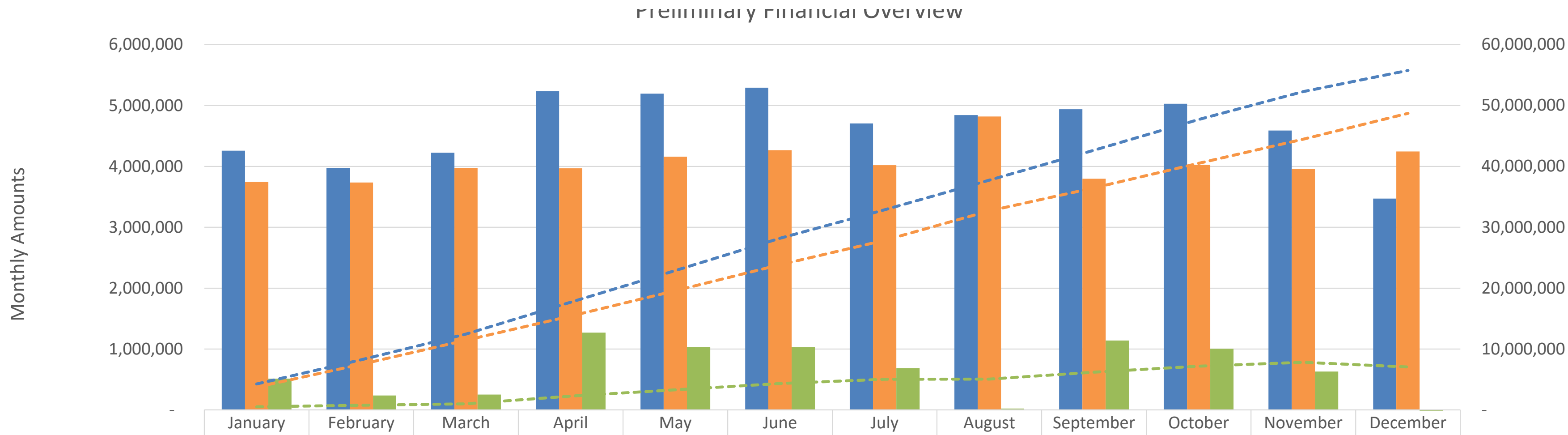
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fixed Route												
YTD Budget	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56	$ 9.56
YTD Actual	7.93	8.13	8.27	8.22	8.30	8.35	8.34	8.45	8.42	8.38	8.39	8.39
Variance - B/(W)	1.62	1.43	1.28	1.34	1.25	1.21	1.21	1.11	1.14	1.18	1.17	1.17
Percentage	83%	85%	87%	86%	87%	87%	87%	88%	88%	88%	88%	88%
DAR/ADA												
YTD Budget	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80	$ 9.80
YTD Actual	11.40	11.00	10.17	10.08	9.95	10.12	10.03	10.12	10.11	10.00	9.92	9.96
Variance - B/(W)	(1.60)	(1.20)	(0.37)	(0.28)	(0.15)	(0.32)	(0.23)	(0.32)	(0.31)	(0.20)	(0.12)	(0.16)
Percentage	116%	112%	104%	103%	102%	103%	102%	103%	103%	102%	101%	102%
Vanpool												
YTD Budget	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53	$ 1.53
YTD Actual	1.43	1.57	0.97	1.10	1.28	1.28	1.29	1.29	1.28	1.27	1.27	1.39
Variance - B/(W)	0.10	(0.04)	0.56	0.43	0.25	0.25	0.24	0.24	0.25	0.27	0.26	0.14
Percentage	93%	103%	64%	72%	84%	84%	84%	84%	84%	83%	83%	91%

Legend for Percent of Budget:

- Better than budget by more than 10%
- +/- 10% of budget
- Worse than budget by 11% - 15%
- Worse than budget by more than 15%

Transit
BEN FRANKLIN TRANSIT

Preliminary Financial Overview



	January	February	March	April	May	June	July	August	September	October	November	December
Monthly Rev	4,258,209	3,972,258	4,225,800	5,237,388	5,195,353	5,294,713	4,706,919	4,841,958	4,937,663	5,030,499	4,590,725	3,471,383
Monthly Exp	3,743,556	3,735,989	3,972,322	3,968,306	4,160,269	4,265,917	4,020,119	4,819,102	3,797,245	4,026,335	3,961,829	4,245,792
Mo. Surplus (Deficit)	514,653	236,269	253,478	1,269,082	1,035,084	1,028,797	686,800	22,856	1,140,418	1,004,164	628,896	(774,409)
YTD Revenues	4,258,209	8,230,467	12,456,266	17,693,655	22,889,008	28,183,721	32,890,640	37,732,598	42,670,260	47,700,759	52,291,484	55,762,867
YTD Expenses	3,743,556	7,479,545	11,451,866	15,420,173	19,580,442	23,846,359	27,866,478	32,685,580	36,482,825	40,509,159	44,470,989	48,716,781
YTD Surplus (Deficit)	514,653	750,922	1,004,400	2,273,482	3,308,566	4,337,362	5,024,162	5,047,018	6,187,436	7,191,600	7,820,496	7,046,086

High Level Summary of Pages that Follow:

Revenue

- Total Actual Operating Revenue has remained within expected budget range throughout the year, pending grants draw down for Dec 2022
- January through October Actual Sales Tax Revenue is better than budget by $3.1 M (8%)
- YTD Operating Grants Revenue is $4.8 M (15%) behind budget due to timing issues with grant drawdown but should catch up at 2022 Financial Year close
- Revenue from ridership has not fully recovered to pre-pandemic levels and it is running slightly behind forecast by 20% mostly due to free youth passes

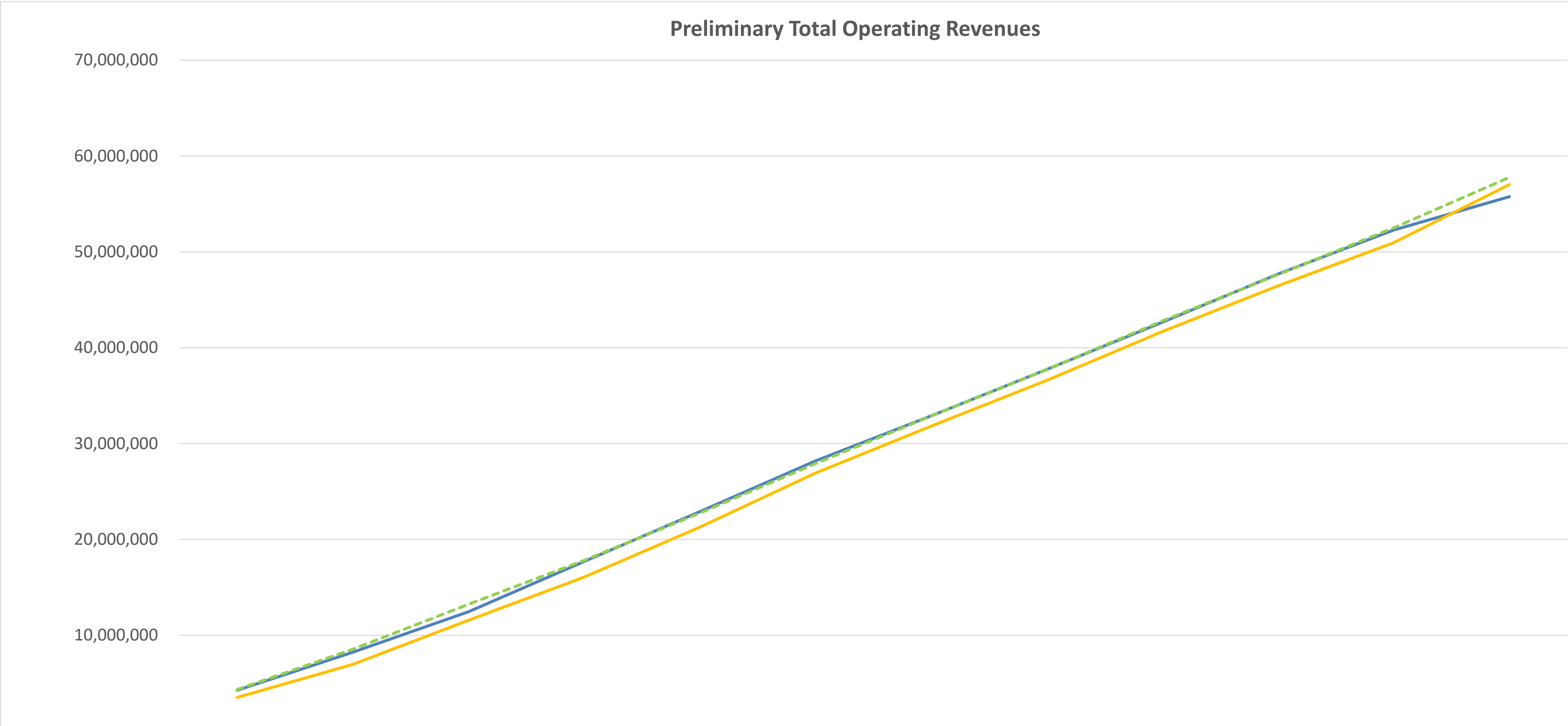
Expenses

- YTD Salaries & Benefits $6.2 M (15.4%)better than budget primarily due to hiring vacancies especially in Operations & Dial-A-Ride
- Dial-A-Ride demand has not returned to pre-pandemic levels, YTD boarding is 22% less than budget forecast, albeit fares are 46% better than forecasted
- Connect is over budget due to higher usage than originally budgeted for 2022 (272% over budget)

-The higher Connect ridership levels will continue throughout the remainder of the year. DAR & ARC budget underruns more than offset this.

-Pending fuel tax refund for December.

Transit
BEN FRANKLIN TRANSIT

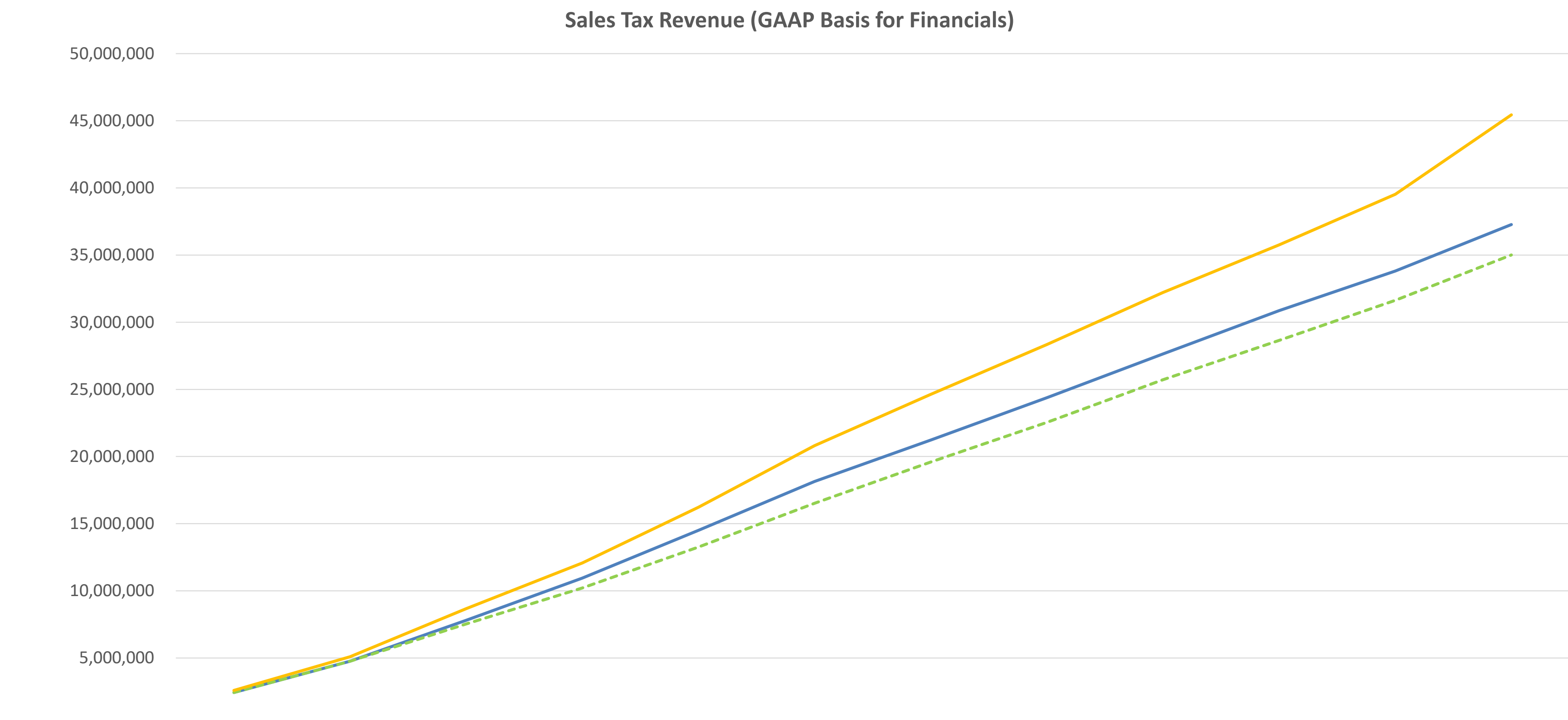


	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CY Actuals YTD	4,258,209	8,230,467	12,456,266	17,693,655	22,889,008	28,183,721	32,890,640	37,732,598	42,670,260	47,700,759	52,291,484	55,762,867
CY Budget	4,327,618	8,550,874	13,229,271	17,808,198	22,753,368	27,902,123	32,869,772	37,729,747	42,802,029	47,631,181	52,511,604	57,786,200
PY Actuals	3,512,917	6,966,312	11,568,537	16,059,413	21,279,540	26,925,331	31,812,315	36,598,044	41,703,233	46,460,326	50,963,526	57,022,837

Significant Items to Note for Total Operating Revenue

Current Month
- Current month revenues are preliminary, pending grant draw downs
- Actuals are within the expected budget range

YTD
- Nothing significant to report for YTD
- Actuals are within the expected budget range



	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CY Actuals YTD	2,429,564	4,754,766	7,810,478	10,943,896	14,504,452	18,144,563	21,222,204	24,382,415	27,640,651	30,867,104	33,814,155	37,273,253
CY Budget	2,429,564	4,754,766	7,535,109	10,215,981	13,263,097	16,513,798	19,583,393	22,545,313	25,719,541	28,650,639	31,633,009	35,009,550
PY Actuals	2,585,589	5,097,165	8,675,101	12,075,673	16,226,240	20,813,518	24,622,039	28,342,359	32,216,068	35,762,246	39,532,023	45,442,171

Significant Items to Note for Sales Tax Revenue

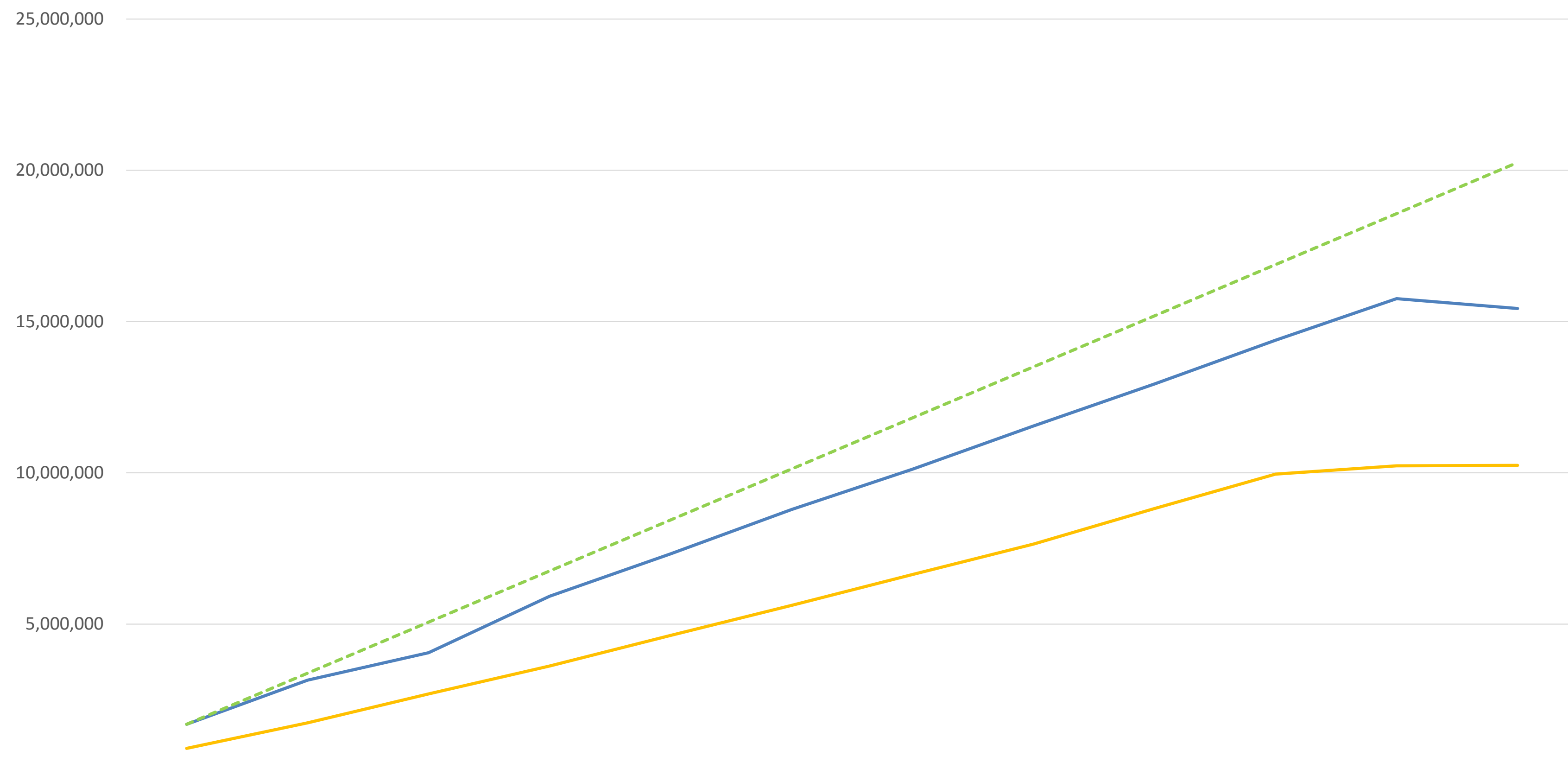
Represents sales tax revenues as recorded in financial statements which will differ from Sales Tax Report due to two month reporting lag from the State.

Current Month
- Current and prior month are estimated due to reporting lag from the State
- Estimate for October adjusted to actual in December. October actuals better than budget by $113k (2.8%)

YTD
- 94% of sales tax revenue went to Operations in PY vs. only 73% in CY
- January through October actuals are better than budget by $3.1 M (8%)

Transit
BEN FRANKLIN TRANSIT

Preliminary Operating Grants



	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CY Actuals YTD	1,686,682	3,147,755	4,054,951	5,919,781	7,318,257	8,788,655	10,122,160	11,548,236	12,938,981	14,383,275	15,757,019	15,429,287
CY Budget	1,688,004	3,376,008	5,064,012	6,752,016	8,440,020	10,128,024	11,816,028	13,504,032	15,192,036	16,880,040	18,568,044	20,256,050
PY Actuals	890,265	1,733,756	2,690,824	3,612,098	4,624,417	5,617,860	6,638,409	7,645,597	8,819,595	9,955,116	10,233,763	10,245,707

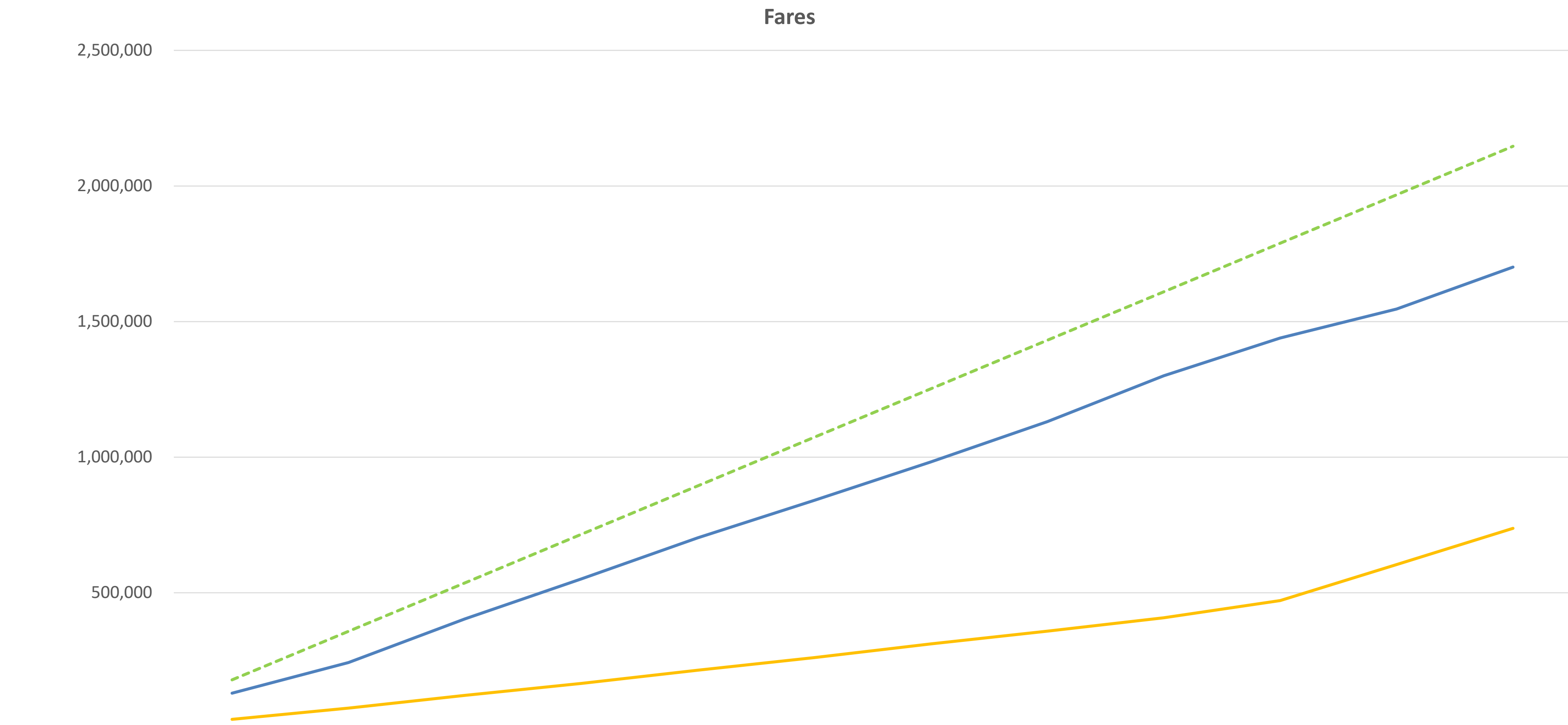
Significant Items to Note for Operating Grants

Current Month

- No State Special Needs funding accrual due to the amount being met.
- Timing issue with grant accrual. Budget was a simple straight-line. This will be caught up after December 2022 financials have been finalized.

YTD

- YTD Operating Grants Revenue are $4.8 M (24%) behind budget primarily due to pending grants accrual for December.



	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CY Actuals YTD	129,714	242,493	403,773	550,883	702,933	840,492	982,001	1,130,614	1,300,168	1,439,036	1,546,409	1,700,869
CY Budget	178,867	357,734	536,601	715,468	894,335	1,073,202	1,252,069	1,430,936	1,609,803	1,788,670	1,967,537	2,146,400
PY Actuals	33,264	74,889	121,461	165,969	214,660	260,999	311,238	358,226	408,036	471,407	604,077	737,558

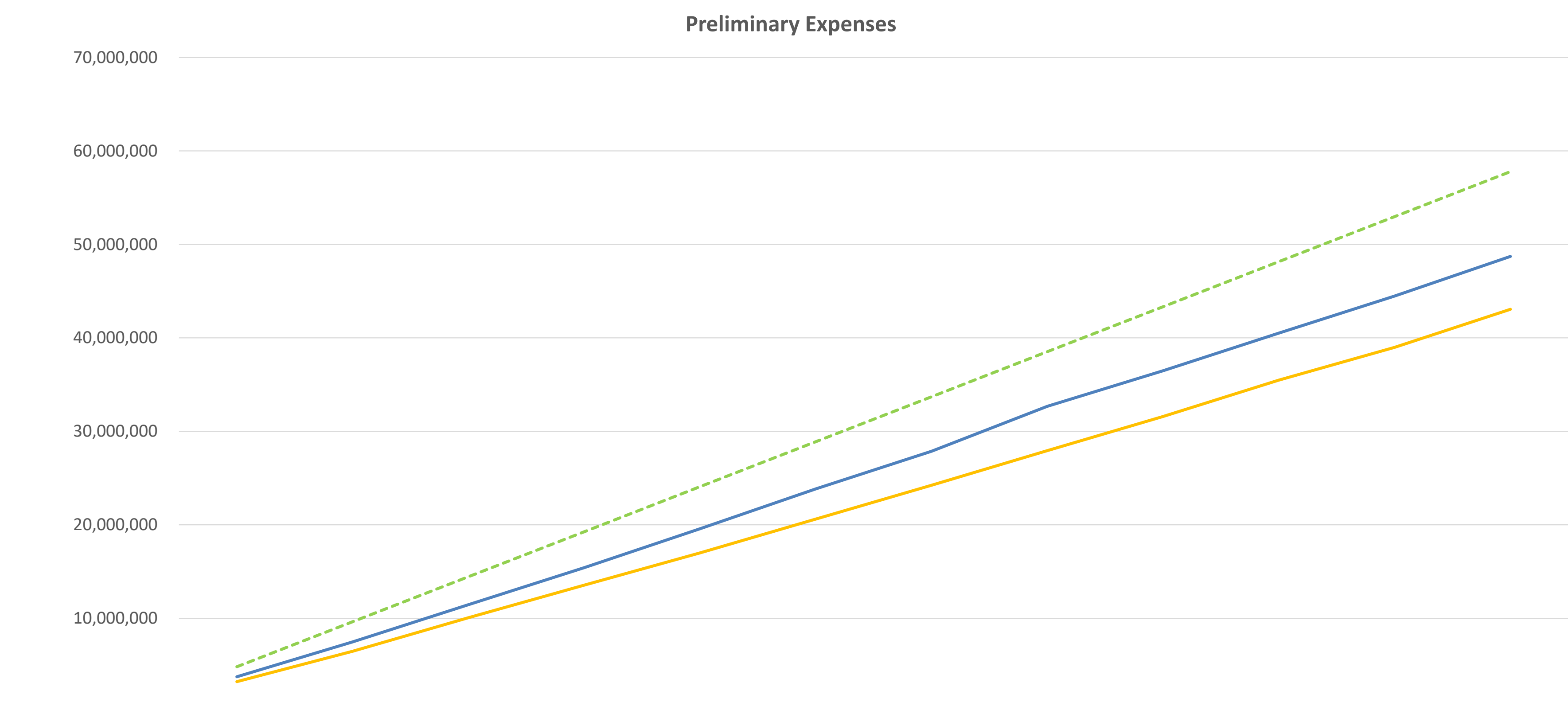
Significant Items to Note for Fares

Current Month

- December fare Actuals are $24K (13.64%) below budget
- Ridership has not fully recovered to pre-pandemic levels, it is running behind forecast by 44k (18%)

YTD

- YTD fares for bus passes are $169 K (21%) behind budget. This is largely due to youth riding free in the last half of the year.
- YTD Connect fares are $179 K (90%) behind budget. This is partly due to riders with bus passes & tickets transferring to Connect in 2022 while in most of 2021, no transfers due to fare free.
- PY was fare-free for Fixed Route and Dial-A-Ride through October 2021
- Ridership has not fully recovered to pre-pandemic levels and it is running 16.6% of 2022 forecasted levels

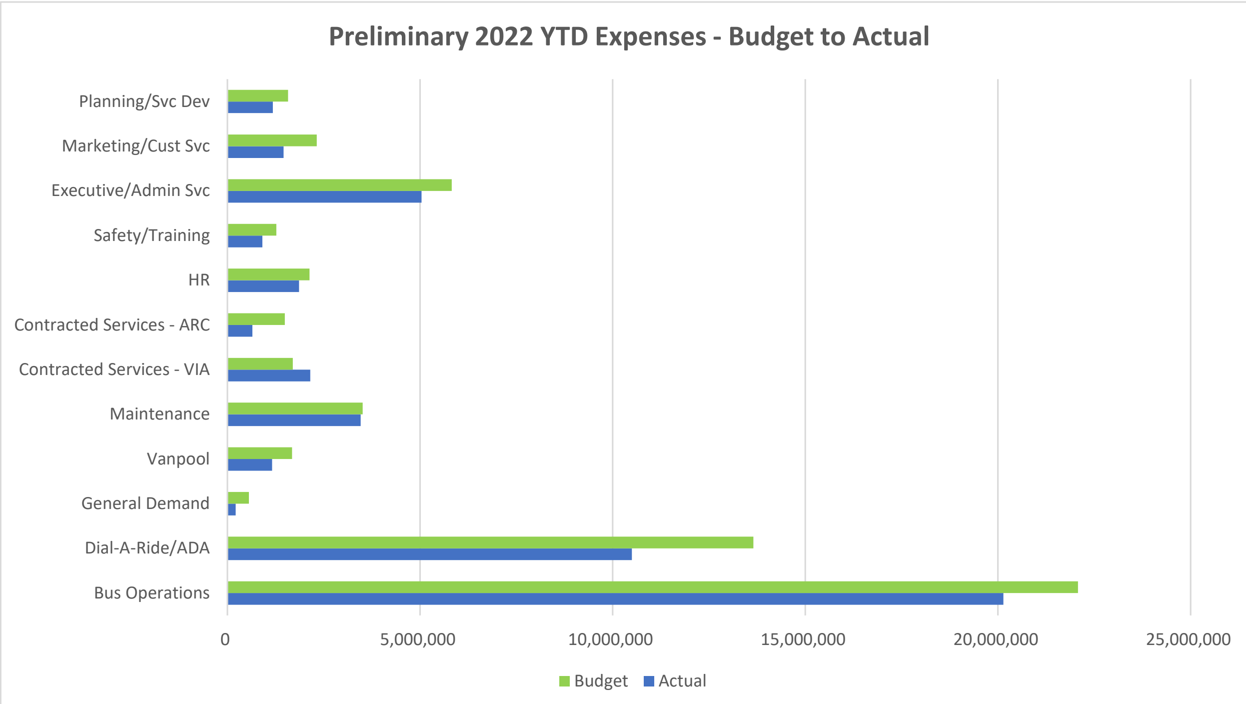


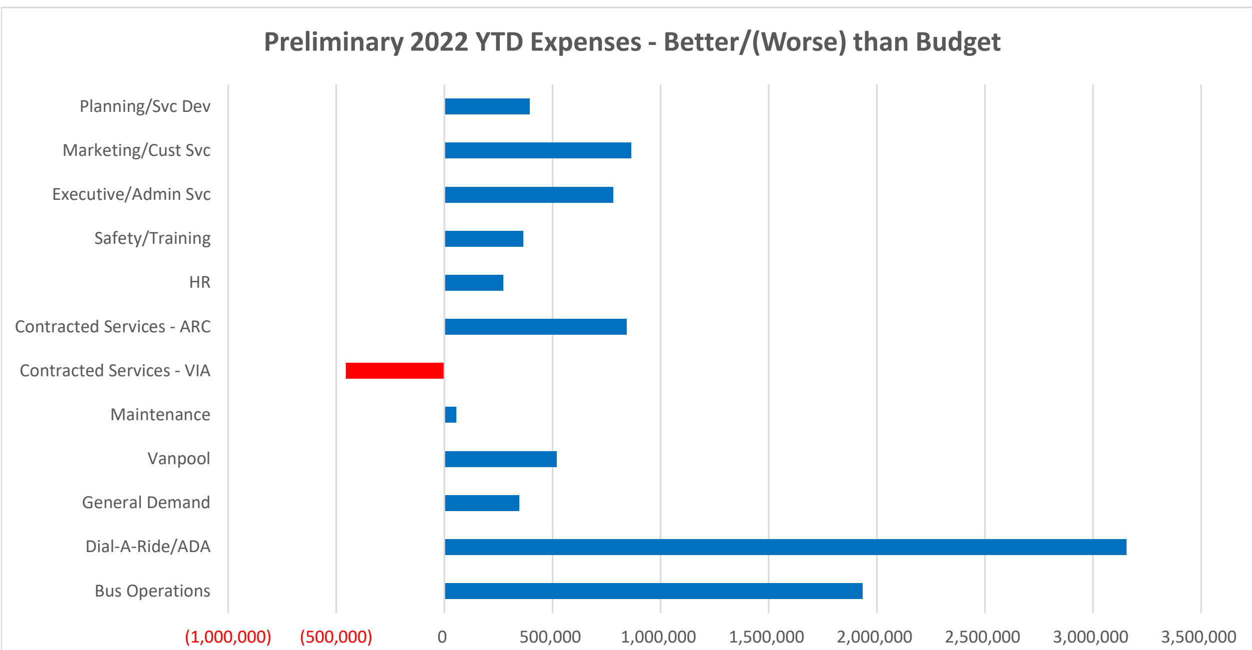
	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
CY Actuals YTD	3,743,556	7,479,545	11,451,866	15,420,173	19,580,442	23,846,359	27,866,478	32,685,580	36,482,825	40,509,159	44,470,989	48,716,781
CY Budget	4,815,517	9,631,034	14,446,551	19,262,068	24,077,585	28,893,102	33,708,619	38,524,136	43,339,653	48,155,170	52,970,687	57,786,200
PY Actuals	3,220,593	6,476,167	10,063,577	13,547,659	16,986,777	20,622,424	24,229,179	27,944,468	31,590,928	35,483,858	38,979,339	43,059,074

Significant Items to Note for Expenses

Current Month
- Pending any December invoices still incoming, and year-end adjustments
- Headcount vacancies contributing to current month underspending
- DAR and ARC continue to run under budget by 22%, pending December year-end adjustments

YTD
- Pending incoming December invoices and year-end adjustments
- YTD Salaries & Benefits $6.2 M better than budget primarily due to hiring vacancies
- DAR and ARC continue to run under budget ($4.3 M)
- Current year includes expanded services that weren't added until June & August of 2021

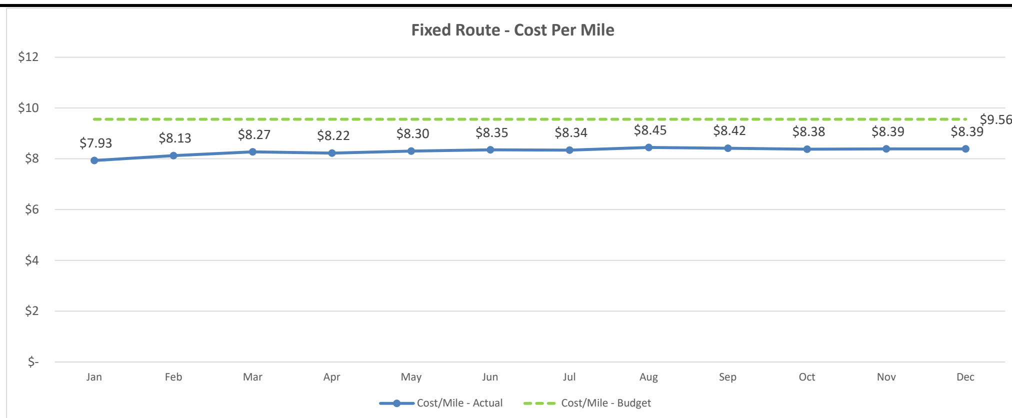




Significant Items to Note:

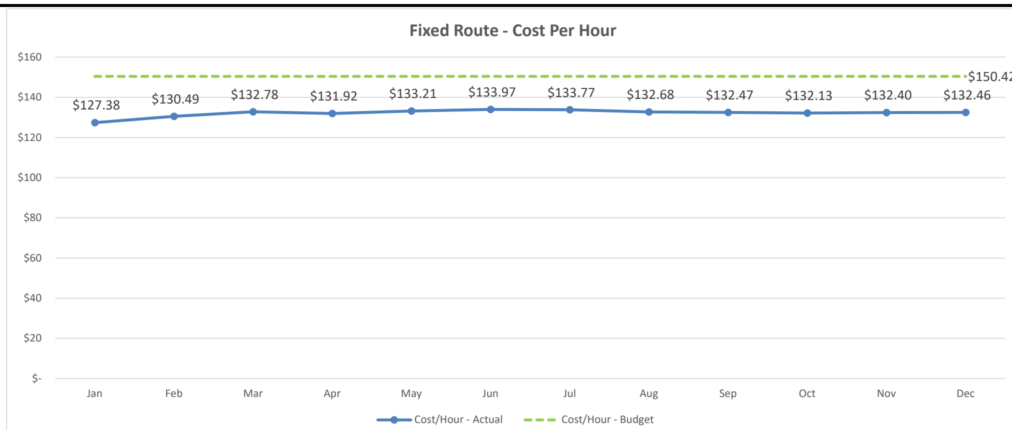
- YTD Salaries & Benefits are better than budget for Operations & Dial-A-Ride primarily due to hiring vacancies
- Pending December fuel tax refund
- Dial-A-Ride demand has not returned to pre-pandemic levels
- Projects/Professional Services are under budget primarily due to straight-line budget vs timing of actual costs
- Contracted Services (Connect) is over budget due to higher usage than originally budgeted for 2022.
- This trend prevailed throughout the year. This overage was offset by budget underruns in DAR & ARC service levels in 2022.

Cost Per Mile



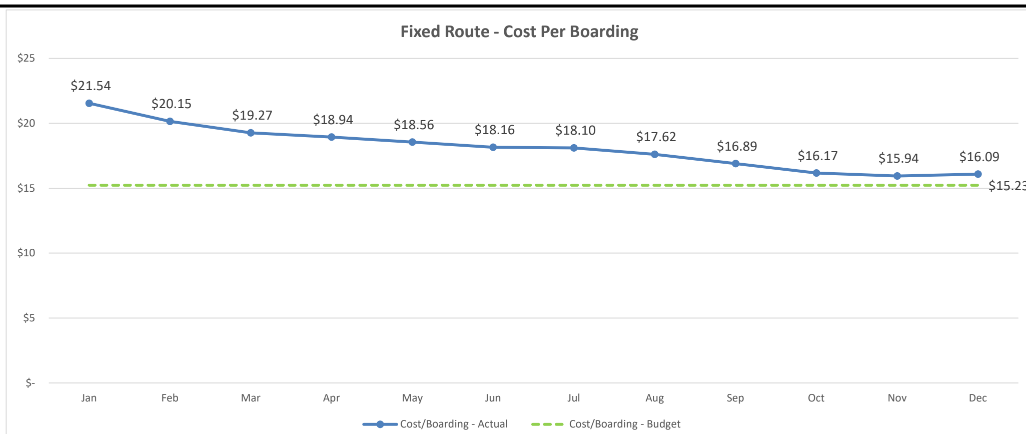
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 2,249,611	$ 4,498,234	$ 7,087,212	$ 9,428,342	$ 11,873,521	$ 14,373,320	$ 16,694,873	$ 19,176,574	$ 21,452,361	$ 23,791,674	$ 26,144,428	$ 28,609,122
Cumulative Miles	283,577	553,395	856,603	1,146,658	1,429,978	1,721,054	2,000,713	2,270,156	2,548,996	2,839,110	3,116,078	3,409,153
Percent of Budget	83%	85%	87%	86%	87%	87%	87%	88%	88%	88%	88%	88%

Cost Per Hour



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 2,249,611	$ 4,498,234	$ 7,087,212	$ 9,428,342	$ 11,873,521	$ 14,373,320	$ 16,694,873	$ 19,176,574	$ 21,452,361	$ 23,791,674	$ 26,144,428	$ 28,609,122
Cumulative Hours	17,660	34,471	53,376	71,470	89,134	107,290	124,800	144,535	161,945	180,066	197,472	215,981
Percent of Budget	85%	87%	88%	88%	89%	89%	89%	88%	88%	88%	88%	88%

Cost Per Boarding



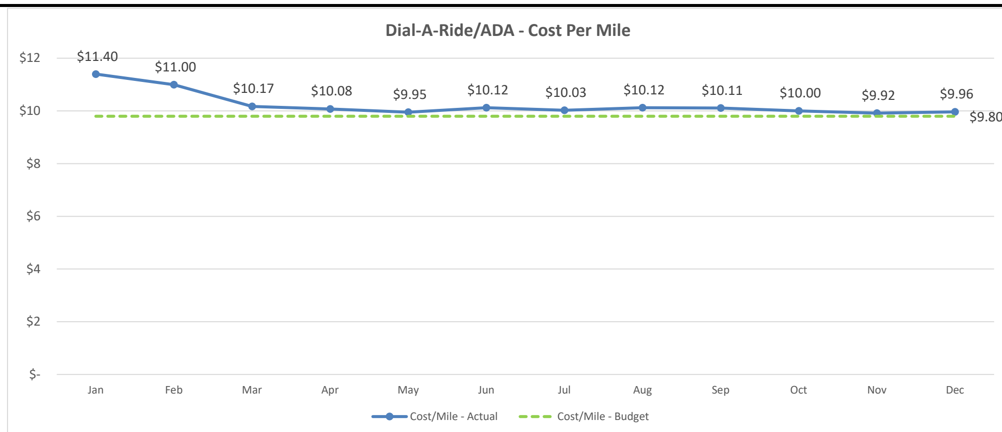
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 2,249,611	$ 4,498,234	$ 7,087,212	$ 9,428,342	$ 11,873,521	$ 14,373,320	$ 16,694,873	$ 19,176,574	$ 21,452,361	$ 23,791,674	$ 26,144,428	$ 28,609,122
Cumulative Boarding	104,416	223,291	367,861	497,739	639,840	791,691	922,214	1,088,575	1,269,839	1,471,175	1,640,017	1,778,008
Percent of Budget	141%	132%	126%	124%	122%	119%	119%	116%	111%	106%	105%	106%

Legend for Percent of Budget:

Better than budget by more than 10%
+/- 10% of budget
Worse than budget by 11% - 15%
Worse than budget by more than 15%

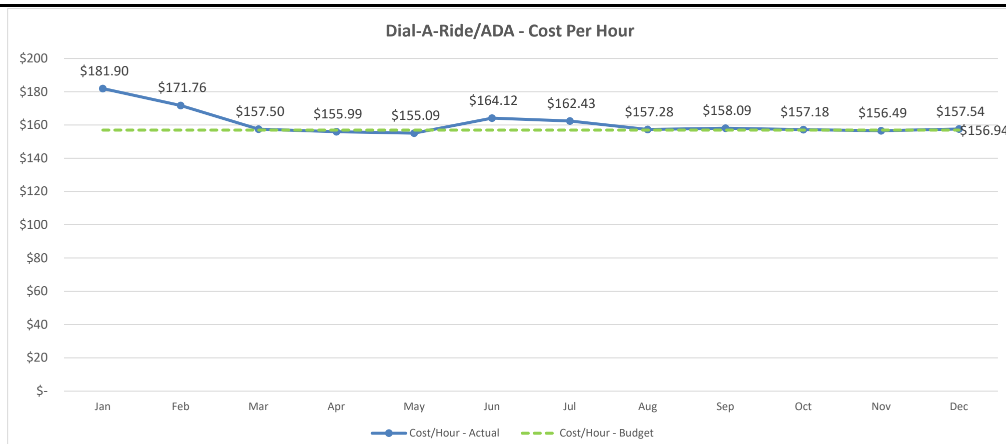
Transit
BEN FRANKLIN TRANSIT

Cost Per Mile



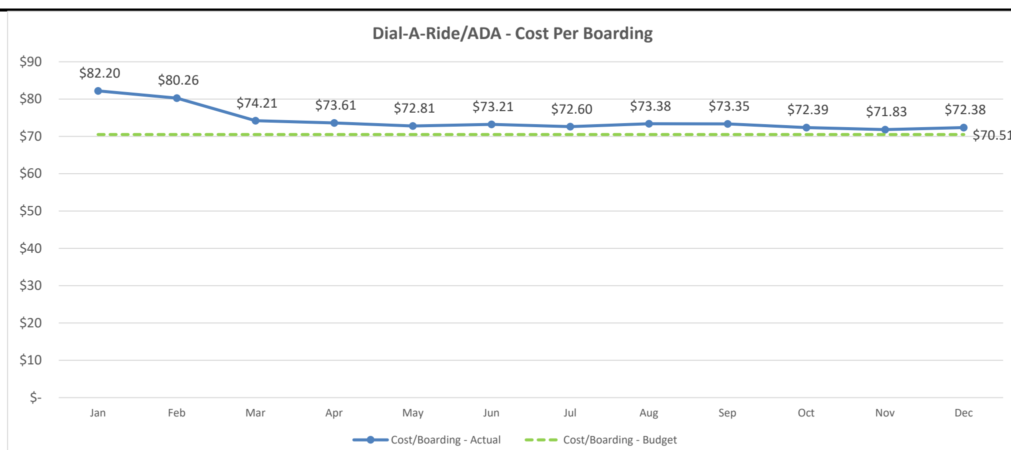
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 1,207,648	$ 2,420,561	$ 3,678,288	$ 4,945,358	$ 6,287,063	$ 7,643,346	$ 8,880,128	$ 10,335,106	$ 11,683,689	$ 13,010,815	$ 14,241,295	$ 15,596,466
Cumulative Miles	105,949	220,086	361,615	490,819	631,816	755,152	885,750	1,021,159	1,155,649	1,300,615	1,436,134	1,565,365
Percent of Budget	116%	112%	104%	103%	102%	103%	102%	103%	103%	102%	101%	102%

Cost Per Hour



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 1,207,648	$ 2,420,561	$ 3,678,288	$ 4,945,358	$ 6,287,063	$ 7,643,346	$ 8,880,128	$ 10,335,106	$ 11,683,689	$ 13,010,815	$ 14,241,295	$ 15,596,466
Cumulative Hours	6,639	14,093	23,354	31,704	40,539	46,572	54,672	65,713	73,906	82,779	91,002	98,999
Percent of Budget	116%	109%	100%	99%	99%	105%	103%	100%	101%	100%	100%	100%

Cost Per Boarding



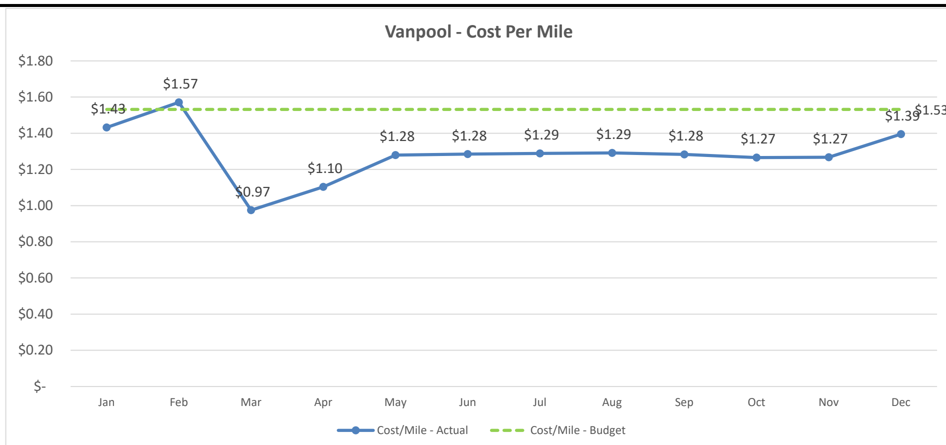
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 1,207,648	$ 2,420,561	$ 3,678,288	$ 4,945,358	$ 6,287,063	$ 7,643,346	$ 8,880,128	$ 10,335,106	$ 11,683,689	$ 13,010,815	$ 14,241,295	$ 15,596,466
Cumulative Boarding	14,692	30,158	49,566	67,186	86,353	104,402	122,310	140,838	159,277	179,741	198,264	215,493
Percent of Budget	117%	114%	105%	104%	103%	104%	103%	104%	104%	103%	102%	103%

Legend for Percent of Budget:

Better than budget by more than 10%
+/- 10% of budget
Worse than budget by 11% - 15%
Worse than budget by more than 15%

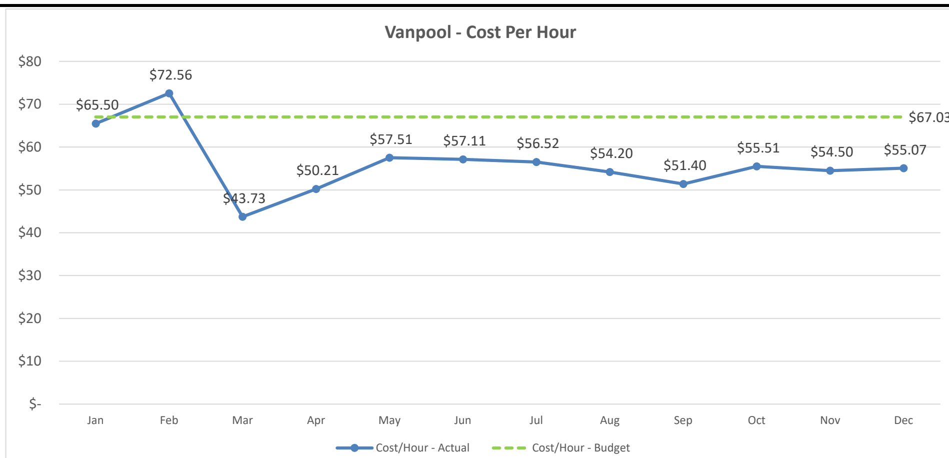
Transit
BEN FRANKLIN TRANSIT

Cost Per Mile



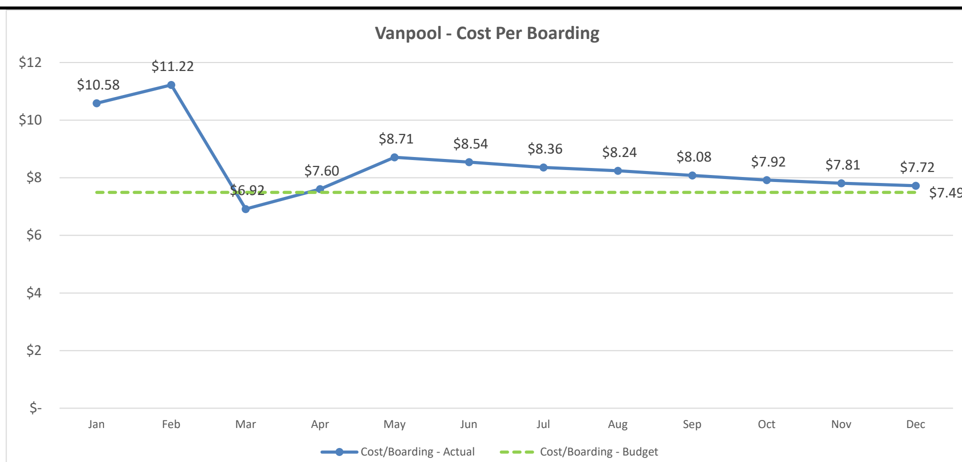
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total Cost	$ 142,234	$ 292,129	$ 276,954	$ 445,155	$ 624,280	$ 823,754	$ 998,738	$ 1,193,534	$ 1,375,706	$ 1,543,085	$ 1,727,075	$ 1,910,172
Total Miles	99,335	185,957	284,120	403,514	487,937	641,308	775,217	924,302	1,072,446	1,219,199	1,362,958	1,369,361
B (W) than Budget	93%	103%	64%	72%	84%	84%	84%	84%	84%	83%	83%	91%

Cost Per Hour



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 142,234	$ 292,129	$ 276,954	$ 445,155	$ 624,280	$ 823,754	$ 998,738	$ 1,193,534	$ 1,375,706	$ 1,543,085	$ 1,727,075	$ 1,910,172
Cumulative Hours	2,172	4,026	6,334	8,865	10,855	14,423	17,671	22,022	26,764	27,799	31,689	34,685
Percent of Budget	98%	108%	65%	75%	86%	85%	84%	81%	77%	83%	81%	82%

Cost Per Boarding



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Cumulative Cost	$ 142,234	$ 292,129	$ 276,954	$ 445,155	$ 624,280	$ 823,754	$ 998,738	$ 1,193,534	$ 1,375,706	$ 1,543,085	$ 1,727,075	$ 1,910,172
Cumulative Boarding	13,437	26,032	40,048	58,536	71,659	96,425	119,520	144,836	170,215	194,882	221,157	247,430
Percent of Budget	141%	150%	92%	102%	116%	114%	112%	110%	108%	106%	104%	103%

Legend for Percent of Budget:

Better than budget by more than 10%
+/- 10% of budget
Worse than budget by 11% - 15%
Worse than budget by more than 15%

Transit
BEN FRANKLIN TRANSIT

Ben Franklin Transit
Preliminary Comparison Revenue & Expenditures to Budget
For the Period Ending Dec 2022

	2022 Total Budget	2022 Budget Year to Date	Actual To Date Dec 2022	% Actuals B (W) Budget YTD	Actual To Date Dec 2021	% 2022 B (W) 2021
Operating Revenues						
Bus Passes	$ 612,300	$ 612,300	$ 497,143	-18.8%	$ 104,093	377.6%
Bus Cash	369,700	369,700	258,948	-30.0%	43,285	498.2%
Dial-A-Ride/ADA	138,000	138,000	202,013	46.4%	36,145	458.9%
General Demand (Prosser) **	16,400	16,400	3,964	-75.8%	1,820	117.8%
Vanpool	810,000	810,000	718,073	-11.3%	549,689	30.6%
Contracted Paratransit	-	-	-	0.0%	-	0.0%
Contracted Services (Via)	200,000	200,000	20,728	-89.6%	2,451	745.8%
Fares	2,146,400	2,146,400	1,700,869	-20.8%	737,558	130.6%
Local Sales Tax (Operating Portion)	35,009,550	35,009,550	37,273,253	6.5%	45,442,171	-18.0%
Operating Grants	1,370,697	1,370,697	1,342,968	-2.0%	178,352	653.0%
CARES Act Funds	18,885,353	18,885,353	14,086,319	-25.4%	10,067,355	39.9%
Miscellaneous	374,200	374,200	1,359,458	263.3%	597,402	127.6%
Total Operating Revenues	**$ 57,786,200**	**$ 57,786,200**	**$ 55,762,867**	**-3.5%**	**$ 57,022,837**	**-2.2%**
Operating Expenditures						
Directly Operated Transportation						
Fixed Route	$ 22,073,300	$ 22,073,300	$ 20,138,892	8.8%	$ 18,368,865	-9.6%
Dial-A-Ride/ADA	13,654,170	13,654,170	10,499,411	23.1%	9,871,295	-6.4%
General Demand (Prosser) **	560,400	560,400	214,986	61.6%	378,388	43.2%
Vanpool	1,680,200	1,680,200	1,160,347	30.9%	1,133,788	-2.3%
Maintenance	3,512,900	3,512,900	3,458,021	1.6%	2,954,131	-17.1%
Purchased Transportation	-		-			
Contracted Services - VIA	1,700,000	1,700,000	2,153,669	-26.7%	380,325	-466.3%
Contracted Services - ARC	1,487,600	1,487,600	645,791	56.6%	978,343	34.0%
Administration	-		-			
HR	2,131,900	2,131,900	1,859,930	12.8%	1,988,366	6.5%
Safety / Training	1,270,700	1,270,700	907,631	28.6%	1,019,586	11.0%
Executive / Administrative Services	5,821,400	5,821,400	5,041,868	13.4%	3,417,130	-47.5%
Marketing / Customer Service	2,321,330	2,321,330	1,457,758	37.2%	1,511,852	3.6%
Planning / Service Development	1,572,300	1,572,300	1,178,477	25.0%	1,057,005	-11.5%
*** Total Operating Expenditures**	**$ 57,786,200**	**$ 57,786,200**	**$ 48,716,781**	**15.7%**	**$ 43,989,096**	**-10.7%**
Operating Surplus/(Deficit)	**$ -**	**$ -**	**$ 7,046,086**		**$ 13,033,742**	
Capital Expenditures						
Local	$ 27,829,006	$ 27,829,006	$ 3,835,285	-86.2%	$ 514,155	645.9%
State	3,908,284	3,908,284	183,125	-95.3%	60,420	203.1%
Federal	4,414,765	4,414,765	4,764,137	7.9%	-	0.0%
Total Capital Expenditures	**$ 36,152,055**	**$ 36,152,055**	**$ 8,782,547**	**-75.7%**	**$ 574,575**	**1428.5%**

* Excludes budgeted GASB 68 year-end pension adjustment.

** Beginning in August 2022, Prosser costs are included with DAR costs.

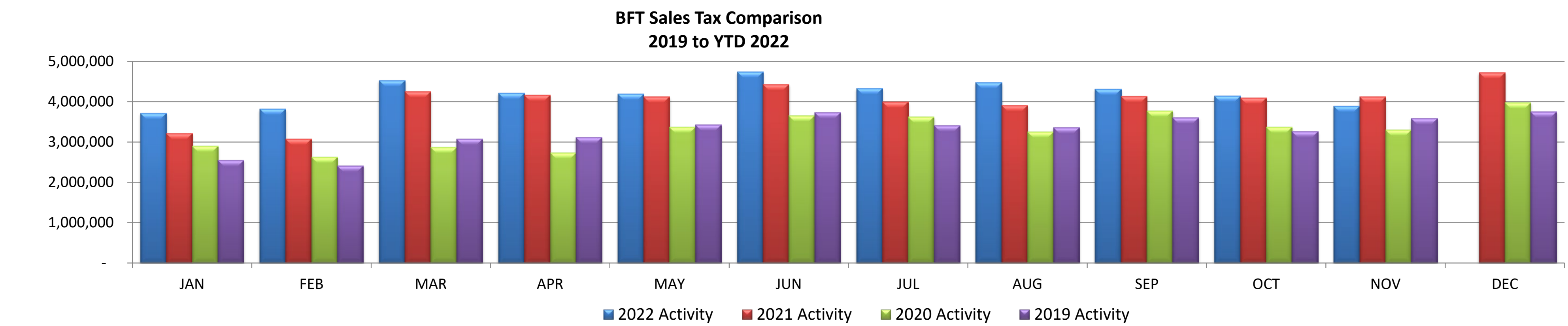
Ben Franklin Transit
Preliminary Comparison Revenue & Expenditures to Budget
For the Period Ending Dec 2022

2022 YTD Actual Allocated Cost Per(s)	**Fixed Route**	**Dial-A-Ride**	**Directly Operated Transportation: General Demand (Prosser)**	**Vanpool**	**Contracted Paratransit**	**Contracted Services (Via)**	**Combined**
Fares	$ 756,091	$ 202,013	$ 3,964	$ 718,073	$ -	$ 20,728	$ 1,700,869
Direct Cost	$ 20,138,892	$ 10,499,411	$ 214,986	$ 1,160,347	$ 645,791	$ 2,153,669	$ 34,813,095
Allocated Cost	$ 8,083,114	$ 5,000,077	$ 205,215	$ 615,279	$ -	$ -	$ 13,903,686
Depreciation - Local (Vehicle only)	$ 387,117	$ 96,978	$ 382	$ 134,545	$ 6,614	$ -	$ 625,635
Cost for Farebox Recovery Ratio	$ 28,609,122	$ 15,596,466	$ 420,583	$ 1,910,172	$ 652,405	$ 2,153,669	49,342,416
Boarding	1,778,008	215,493	2,475	247,430	30,094	115,418	2,388,918
Revenue Miles	3,409,153	1,565,365	11,483	1,369,361	86,140	956,237	7,397,739
Revenue Hours	215,981	98,999	603	34,685	4,386	45,522	400,176
Cost per Boarding	**$ 16.09**	**$ 72.38**	**$ 169.94**	**$ 7.72**	**$ 21.68**	**$ 18.66**	**$ 20.65**
Cost per Rev Mile	**$ 8.39**	**$ 9.96**	**$ 36.63**	**$ 1.39**	**$ 7.57**	**$ 2.25**	**$ 6.67**
Cost per Rev Hour	**$ 132.46**	**$ 157.54**	**$ 697.48**	**$ 55.07**	**$ 148.75**	**$ 47.31**	**$ 123.30**
Farebox Recovery	2.6%	1.3%	0.9%	37.6%	0.0%	1.0%	3.4%

2022 YTD Budgeted Allocated Cost Per(s)	**Fixed Route**	**Dial-A-Ride**	**Directly Operated Transportation: General Demand (Prosser)**	**Vanpool**	**Contracted Paratransit**	**Contracted Services (Via)**	**Combined**
Fares	$ 982,000	$ 138,000	$ 16,400	$ 810,000	$ -	$ 200,000	$ 2,146,400
Direct Cost	$ 22,073,300	$ 13,654,170	$ 560,400	$ 1,680,200	$ 1,487,600	$ 1,700,000	$ 41,155,670
Allocated Cost	$ 9,671,564	$ 5,717,985	$ 245,057	$ 718,832	$ -	$ -	$ 16,353,438
Depreciation - Local (Vehicle only)	$ 444,755	$ 87,949	$ 211	$ 148,203	$ 7,256	$ -	$ 688,374
* Cost for Farebox Recovery Ratio	$ 32,189,619	$ 19,460,104	$ 805,668	$ 2,547,235	$ 1,494,856	$ 1,700,000	$ 58,197,482
Boarding	2,113,000	276,000	26,000	340,000	78,000	31,000	2,864,000
Revenue Miles	3,368,000	1,986,000	146,000	1,663,000	223,000	376,000	7,762,000
Revenue Hours	214,000	124,000	6,800	38,000	14,000	36,000	432,800
Cost per Boarding	**$ 15.23**	**$ 70.51**	**$ 30.99**	**$ 7.49**	**$ 19.16**	**$ 54.84**	**$ 20.32**
Cost per Rev Mile	**$ 9.56**	**$ 9.80**	**$ 5.52**	**$ 1.53**	**$ 6.70**	**$ 4.52**	**$ 7.50**
Cost per Rev Hour	**$ 150.42**	**$ 156.94**	**$ 118.48**	**$ 67.03**	**$ 106.78**	**$ 47.22**	**$ 134.47**
Farebox Recovery	3.1%	0.7%	2.0%	31.8%	0.0%	11.8%	3.7%

December 2022 Actuals Better (Worse) than Budget							
Cost per Boarding	**$ (0.86)**	**$ (1.87)**	**$ (138.96)**	**$ (0.23)**	**$ (2.51)**	**$ 36.18**	**$ (0.33)**
Cost per Rev Mile	**$ 1.17**	**$ (0.16)**	**$ (31.11)**	**$ 0.14**	**$ (0.87)**	**$ 2.27**	**$ 0.83**
Cost per Rev Hour	**$ 17.96**	**$ (0.61)**	**$ (579.00)**	**$ 11.96**	**$ (41.97)**	**$ (0.09)**	**$ 11.17**

* Excludes budgeted GASB 68 year-end pension adjustment.



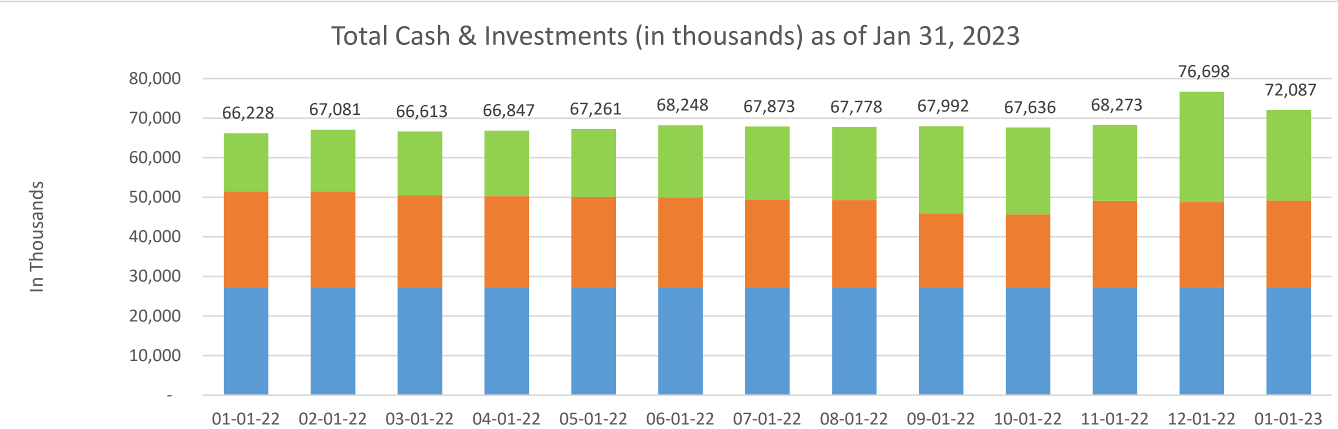
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL	YTD
2022 Activity	3,718,461	3,818,560	4,527,951	4,220,707	4,199,919	4,741,316	4,335,247	4,477,763	4,315,048	4,142,860	3,892,338		46,390,170	$ 46,390,170
2021 Activity	3,217,469	3,080,269	4,253,848	4,162,484	4,127,491	4,434,171	3,995,092	3,907,965	4,136,176	4,100,560	4,129,726	4,726,262	48,271,512	$ 43,545,250
2020 Activity	2,897,013	2,628,492	2,869,290	2,734,647	3,377,653	3,655,389	3,621,523	3,259,755	3,773,316	3,372,348	3,302,921	3,981,314	39,473,663	$ 35,492,349
2019 Activity	2,551,215	2,415,542	3,083,917	3,115,786	3,434,191	3,737,774	3,407,206	3,356,617	3,609,415	3,259,950	3,585,466	3,754,832	39,311,911	$ 35,557,079
Chg 22 to 21	500,991	738,291	274,103	58,223	72,428	307,145	340,156	569,799	178,872	42,300	(237,388)	-	2,844,920	
Chg 21 to 20	320,456	451,777	1,384,558	1,427,837	749,838	778,782	373,568	648,209	362,860	728,212	826,805	744,948	8,797,849	
Chg 20 to 19	345,798	212,951	(214,627)	(381,139)	(56,538)	(82,385)	214,317	(96,862)	163,901	112,398	(282,544)	226,482	161,752	
Chg 19 to 18	2,961	(193,422)	(113,890)	142,595	216,986	431,826	332,900	224,348	544,731	245,049	657,905	377,682	2,869,673	
% Chg 22 to 21	15.6%	24.0%	6.4%	1.4%	1.8%	6.9%	8.5%	14.6%	4.3%	1.0%	-5.7%		6.5%	
% Chg 21 to 20	11.1%	17.2%	48.3%	52.2%	22.2%	21.3%	10.3%	19.9%	9.6%	21.6%	25.0%	18.7%	22.3%	
% Chg 20 to 19	13.6%	8.8%	-7.0%	-12.2%	-1.6%	-2.2%	6.3%	-2.9%	4.5%	3.4%	-7.9%	6.0%	0.4%	
% Chg 19 to 18	0.1%	-7.4%	-3.6%	4.8%	6.7%	13.1%	10.8%	7.2%	17.8%	8.1%	22.5%	11.2%	7.9%	
2022 Budget	3,339,912	3,196,447	3,822,127	3,685,386	4,188,859	4,468,726	4,219,761	4,071,741	4,363,599	4,029,370	4,099,852	4,641,719	48,127,500	$ 43,485,781
2021 Budget	2,746,574	2,667,953	3,329,812	3,199,984	3,484,955	3,910,393	3,403,113	3,428,179	3,522,917	3,287,186	3,391,233	3,827,701	40,200,000	$ 36,372,299
2020 Budget	2,627,752	2,488,008	3,176,434	3,209,259	3,537,217	3,849,908	3,166,535	3,226,237	3,156,625	3,105,347	3,015,387	3,478,464	38,037,173	$ 34,558,709
2019 Budget	2,650,000	2,750,000	3,310,000	3,080,000	3,330,000	3,420,000	3,200,000	3,000,000	3,080,000	2,810,000	2,860,000	3,460,000	36,950,000	$ 33,490,000
Vs. 2022 Budget	378,549	622,113	705,824	535,321	11,060	272,590	115,486	406,023	(48,551)	113,489	(207,515)	-	2,904,389	6.7%
Vs. 2021 Budget	470,895	412,316	924,036	962,500	642,536	523,778	591,979	479,786	613,259	813,374	738,493	898,561	8,071,512	19.7%
Vs. 2020 Budget	269,262	140,484	(307,145)	(474,612)	(159,563)	(194,518)	454,989	33,518	616,691	267,000	287,534	502,850	1,436,490	2.7%
Vs. 2019 Budget	(98,785)	(334,458)	(226,083)	35,786	104,191	317,774	207,206	356,617	529,415	449,950	725,466	294,832	2,361,911	6.2%

Ben Franklin Transit
Treasurer's Report

Date:	February 9, 2023
To:	Ben Franklin Transit Board of Directors
From:	Finance Department
Subject:	Treasurer's Report - As of Jan 31, 2023

The Investment Position of Ben Franklin Transit as of the Close of Business on Jan 31, 2023 is as follows:

ITEM	DATE OF PURCHASE	RATE	MATURITY		COST	% OF TOTAL
WA State Government Investment Pool		4.3952%	Open	$	49,240,728	68.3%
US Bank Commercial Paper Sweep Acct		0.0000%	Open		-	0.0%
Subtotal Investments					**49,240,728**	68.3%
Check Book Balance, Petty Cash, & Travel Account			*		22,846,198	31.7%
						100.0%
Total Cash and Equivalents on Hand				**$**	**72,086,926**	
Less Reserve Funds						
Operating Reserves					(14,759,000)	
Fuel Reserves					(2,547,819)	
Fleet Replacement Reserves					(5,315,574)	
Non-Fleet Capital Reserves					(6,656,029)	
Total Reserves					**(29,278,422)**	
Subtotal Funds Available					**42,808,504**	
Local Funds for Current Capital Projects		**Approved Budget**	**12 Month Estimate**		**(22,068,693)**	
Fleet Vehicles		(1,920,415)	(4,849,657)			
Facilities - Transit Centers & Amenities		(19,694,810)	(6,550,606)			
Facilities - MOA Campus		(17,320,356)	(7,434,007)			
Technology		(6,921,772)	(920,382)			
Other		(5,766,462)	(2,314,041)			
Net Funds Available				**$**	**20,739,811**	



	01-31-22	02-28-22	03-31-22	04-30-22	05-31-22	06-30-22	07-31-22	08-31-22	09-30-22	10-31-22	11-30-22	12-31-22	01-31-23
Total Cash on Hand	66,228	67,081	66,613	66,847	67,261	68,248	67,873	67,778	67,992	67,636	68,273	76,698	72,087
Available	14,717	15,570	16,026	16,553	17,141	18,281	18,420	18,471	22,046	21,913	19,190	27,916	22,919
12 Mo Capital	24,412	24,412	23,488	23,194	23,021	22,867	22,354	22,208	18,846	18,624	21,983	21,683	22,069
Reserves	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099	27,099