

# HB 2017 Transit Advisory Committee

January 21, 2022



# Webex Tutorial

## Chat

- Right side window
- Chats are recorded

## Participants

- Right side window
- Raise your hand

Video On/Off

Reactions

Mute/Unmute

Leave Meeting



The toolbar contains the following elements from left to right: a 'Mute/Unmute' button with a microphone icon and a dropdown arrow; a 'Stop video' button with a video camera icon and a dropdown arrow; a 'Share' button with a screen icon; a refresh icon; a three-dot menu icon; a red 'Leave Meeting' button with a white 'X' icon; an 'Apps' button with a grid icon; a participants icon with three people; a chat icon with a speech bubble; and a final three-dot menu icon.

# Meeting Agenda

Public Comment	8:30 a.m.
Introduce New Committee Members	8:35 a.m.
Committee Chair Position	8:40 a.m.
Review Equity Map	8:45 a.m.
Zero Emission Bus Update	9:15 a.m.

# Public Comment



# New Committee Members/ Vacant Positions

Member	Organization	Representing
Cameron Bennet	PSU	Students
Sarah Iannarone	The Street Trust	Active Transportation
Vacant	Metro	Metro
Vacant	TBD	Environmental
Vacant	TBD	Multnomah County Riders

# Committee Chair

## 2020-21 Committee Chairs

- Jarvez Hall
- Deanna Palm

Committee bylaws require a committee vote for co-chairs:

*Section V.a.: Committee and subcommittee officers will be elected by a simple majority.*

**Vote for Committee Co-Chairs at Feb. meeting**

# Equity Maps

## Equity Map Process

- HB 2017 legislation calls for investments to occur in “low income” communities
  - Advisory committees must define “low income”.
- HB 2017 Transit Advisory Committee has used TriMet’s Equity Index

# TriMet Equity Index

## Equity Index 10 Factor Analysis:

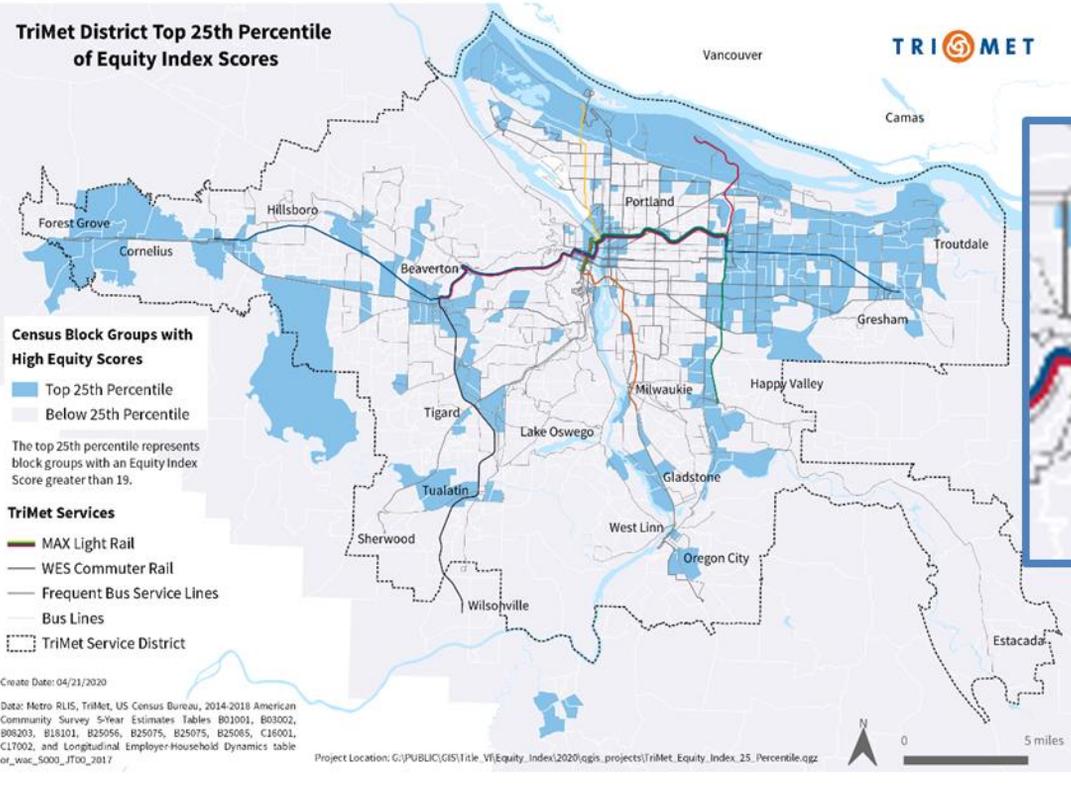
- Low income population (200% of poverty)
- People of color
- Limited English proficiency
- People with disabilities
- Senior population
- Youth population
- Low & medium wage jobs
- Limited vehicle access
- Affordable housing units
- Key retail/human/social services

**FY22-23 Map: Top scoring quartile composed the equity areas**

**Change from FY22-23: Separate maps for county areas outside of TriMet**

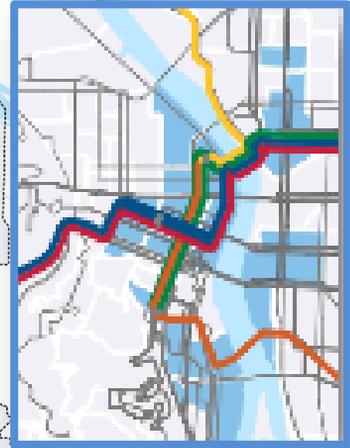
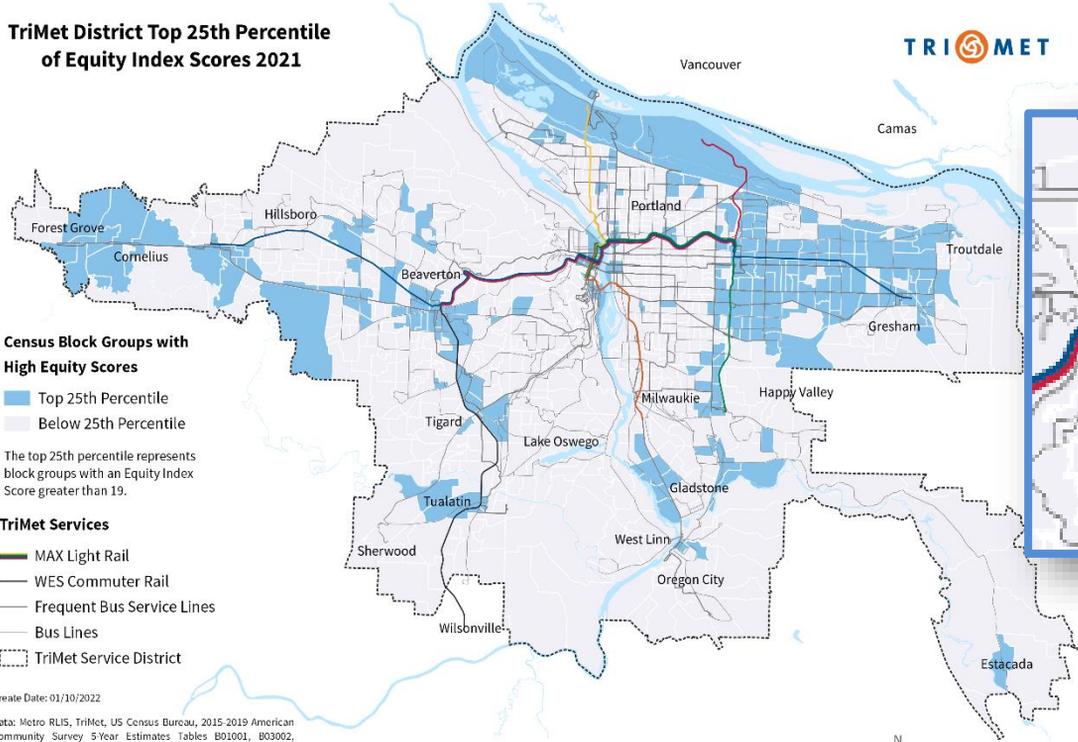
# FY22-23 Equity Map

## TriMet District Top 25th Percentile of Equity Index Scores



# FY24-25 Equity Map - TriMet

## TriMet District Top 25th Percentile of Equity Index Scores 2021



### Census Block Groups with High Equity Scores

- Top 25th Percentile
- Below 25th Percentile

The top 25th percentile represents block groups with an Equity Index Score greater than 19.

### TriMet Services

- MAX Light Rail
- WES Commuter Rail
- Frequent Bus Service Lines
- Bus Lines
- TriMet Service District

Create Date: 01/10/2022

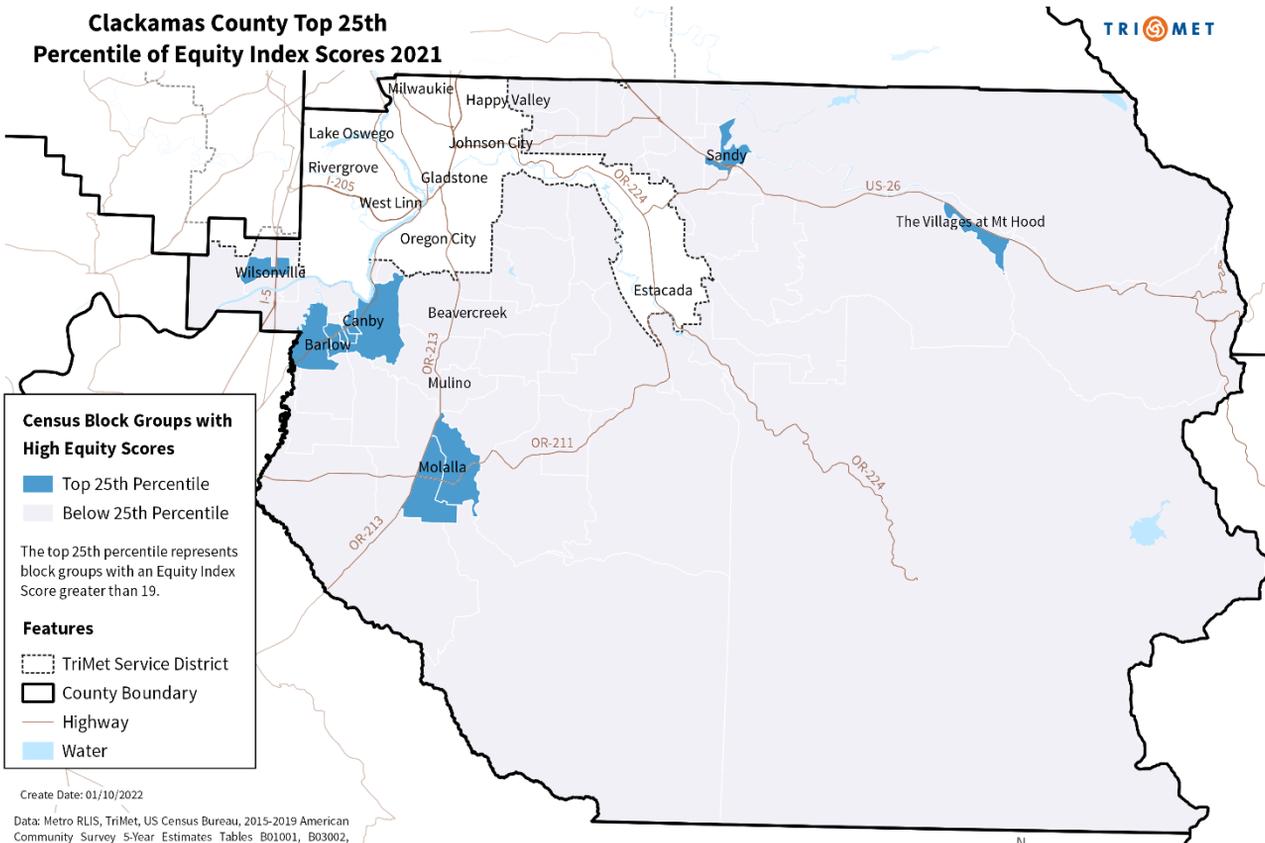
Data: Metro RLIS, TriMet, US Census Bureau, 2015-2019 American Community Survey 5-Year Estimates Tables B01001, B03002, B08203, B18101, B25056, B25075, B25075, B25085, C16001, C17002, and Longitudinal Employer-Household Dynamics table or\_wac\_s000\_J700\_2019

Project Location: G:\PUBLIC\GIS\Title\_VII\Equity\_Index\2021\STIP\gis\_maps\TriMet\_Equity\_Index\_25\_Percentile.gpx



# FY24-25 Equity Map - Clackamas

## Clackamas County Top 25th Percentile of Equity Index Scores 2021



Create Date: 01/10/2022

Data: Metro RLIS, TriMet, US Census Bureau, 2015-2019 American Community Survey 5-Year Estimates Tables B01001, B03002, B08203, B18101, B25056, B25075, B25075, B25075, B25085, C16001, C17002, and Longitudinal Employer-Household Dynamics table or\_wac\_S000\_JT00\_2019

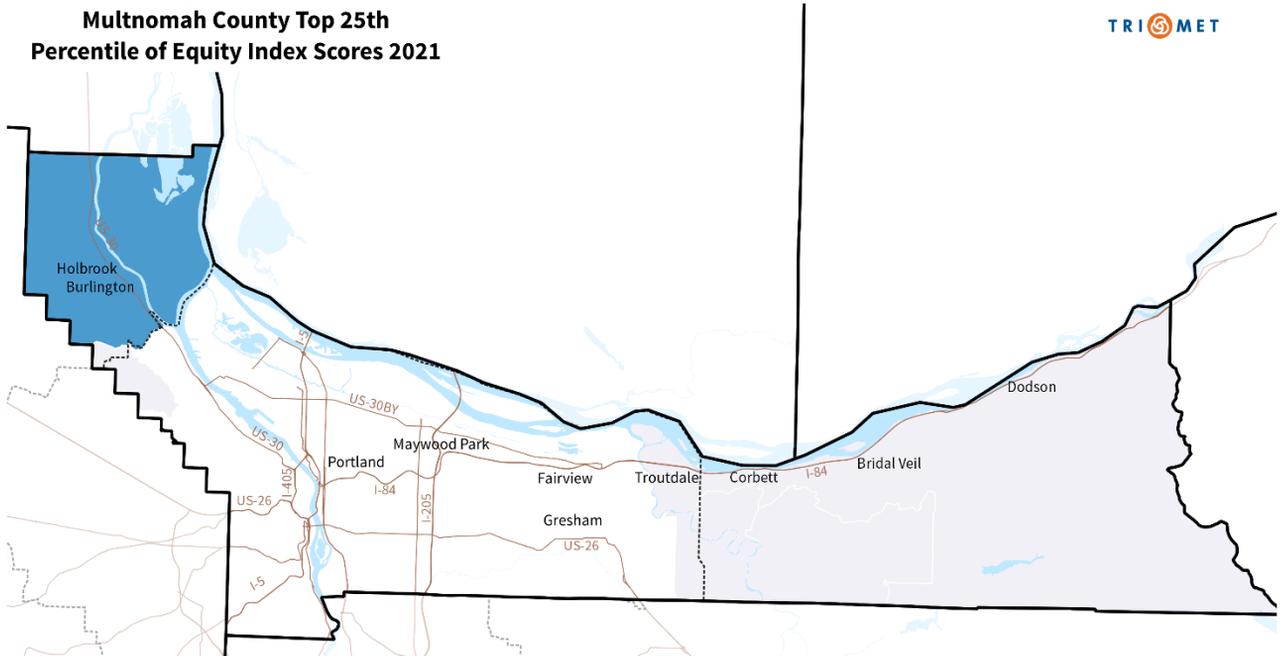
Project Location: G:\PUBLIC\GIS\Title\_VII\Equity\_Index\2021\STIF\qgis\_maps\Clackamas\_Equity\_Index\_25\_Percentile.qgz



0 5 miles

# FY24-25 Equity Map - Multnomah

## Multnomah County Top 25th Percentile of Equity Index Scores 2021



Census Block Groups with High Equity Scores	Features
Top 25th Percentile	TriMet Service District
Below 25th Percentile	County Boundary
	Highway
	Water

The top 25th percentile represents block groups with an Equity Index Score greater than 18.

Data: Metro RLIS, TriMet, US Census Bureau, 2015-2019 American Community Survey 5-Year Estimates Tables B01001, B03002, B08203, B18101, B25056, B25075, B25075, B25085, C16001, C17002, and Longitudinal Employer-Household Dynamics table of\_wac\_s000\_IT00\_2019



Create Date: 01/10/2022

Project Location: G:\PUBLIC\GIS\Title\_VII\Equity\_Index\2021\STIF\ogis\_maps\Multnomah\_Equity\_Index\_25\_Percentile.gz

# FY24-25 Equity Map - Washington

## Washington County Top 25th Percentile of Equity Index Scores 2021



### Census Block Groups with High Equity Scores

- Top 25th Percentile
- Below 25th Percentile

The top 25th percentile represents block groups with an Equity Index Score greater than 18.

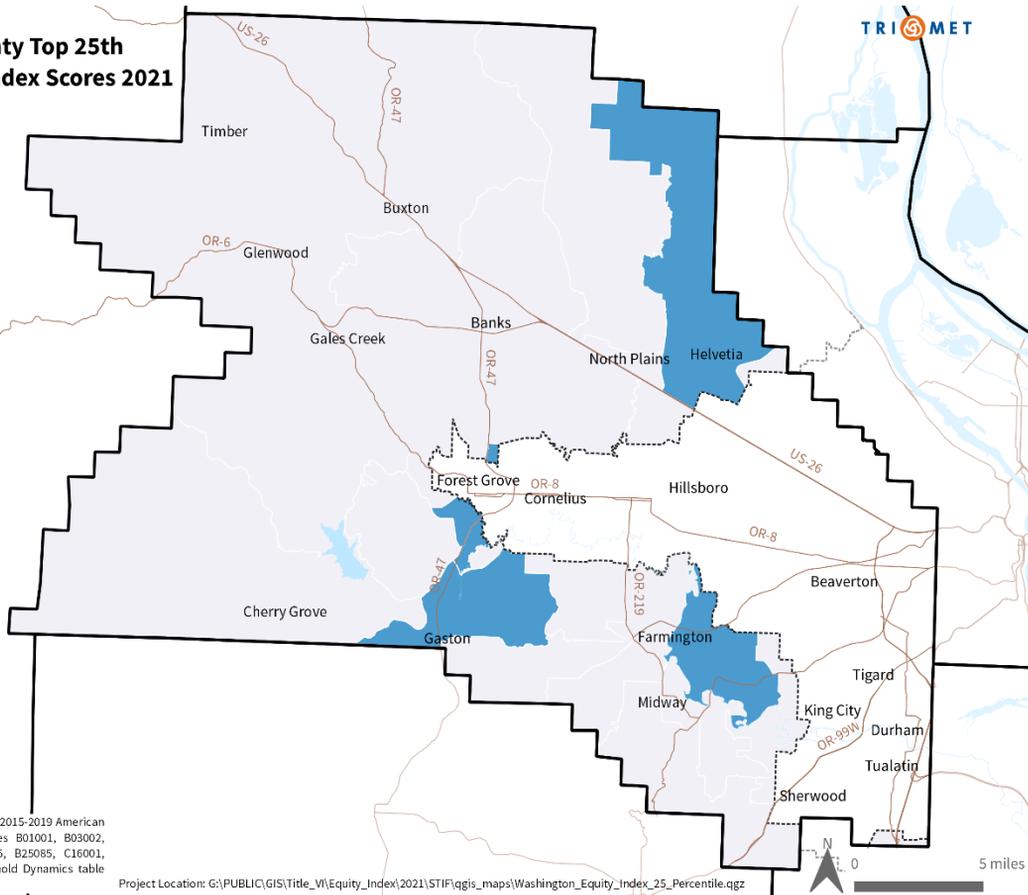
### Features

- TriMet Service District
- County Boundary
- Highway
- Water

Create Date: 01/10/2022

Data: Metro RLIS, TriMet, US Census Bureau, 2015-2019 American Community Survey 5-Year Estimates Tables B01001, B03002, B08203, B18101, B25056, B25075, B25075, B25085, C16001, C17002, and Longitudinal Employer-Household Dynamics table or\_wac\_5000\_JT00\_2019

Project Location: G:\PUBLIC\GIS\Title\_VI\Equity\_Index\2021\STIF\qgis\_maps\Washington\_Equity\_Index\_25\_Percentile.qgz



# TriMet's Zero Emissions Bus Fleet:

## Progress to Date and Future Plans



# Background

- **TriMet committed to a full fleet transition by 2040**
- **Since 2018, we have been testing several types of buses**



# New Flyer (Short-Range Battery Electric)



- 5 buses total operating on Line 62
- Charge at Merlo Garage and Sunset Transit Center
- Early challenges with reliability

# Gillig

## (Long-Range Battery Electric)



- 5 buses total
- Charge at Merlo Garage
- Operating on Lines 6, 20

# Diesel-to-Electric Conversions



**40' Gillig Bus, converted by Complete Coach Works**



**60' New Flyer Bus, converted by Complete Coach Works**

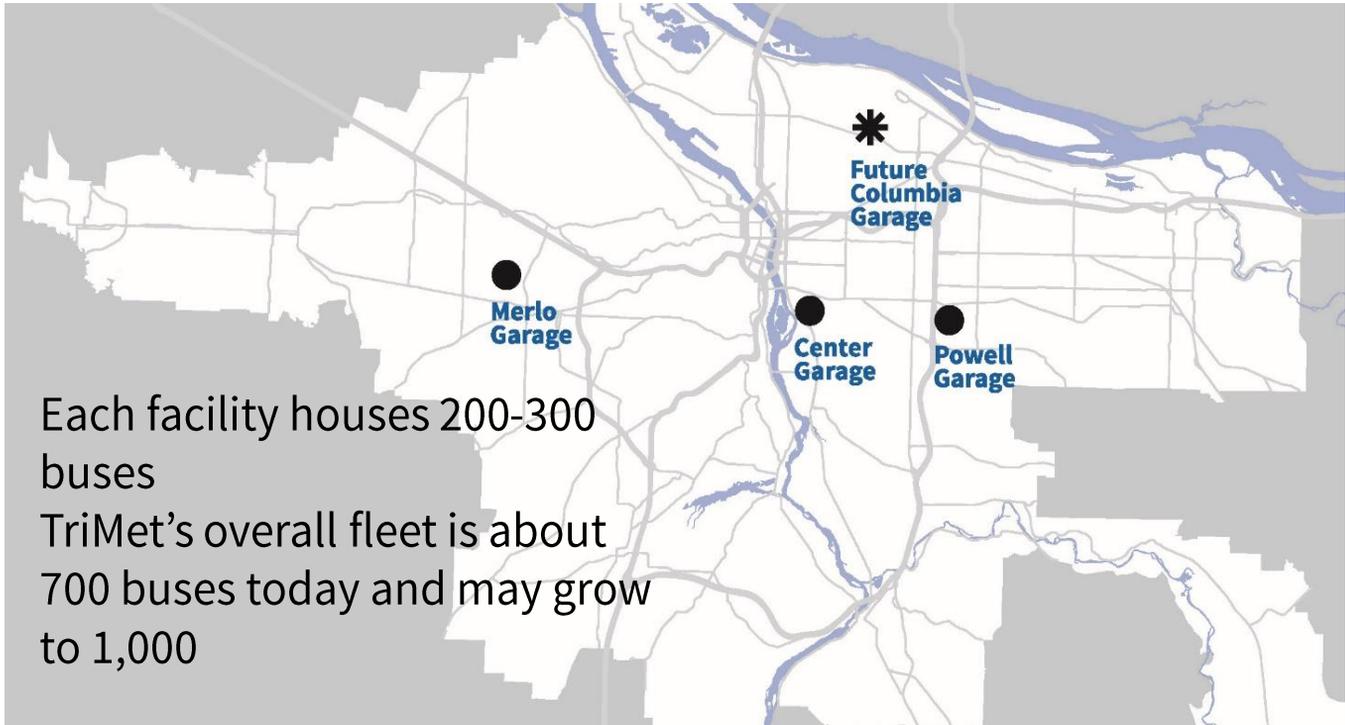
# New Flyer Long-Range Buses on Loan



Buses from King County Metro that have been  
loaned to us for 1 year

# Future Planning: Bus Facilities

# Bus Facilities



- Each facility houses 200-300 buses
- TriMet's overall fleet is about 700 buses today and may grow to 1,000

# Ground-Mounted to Overhead Charging

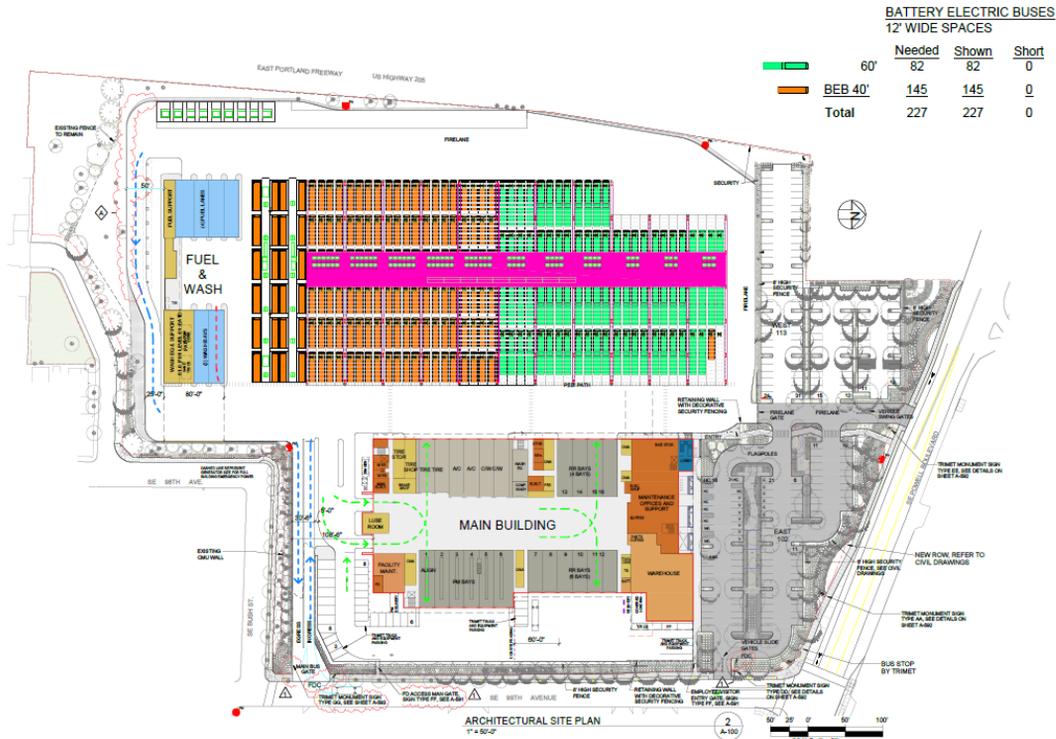


Existing ground-mounted plug in charger at Merlo Garage



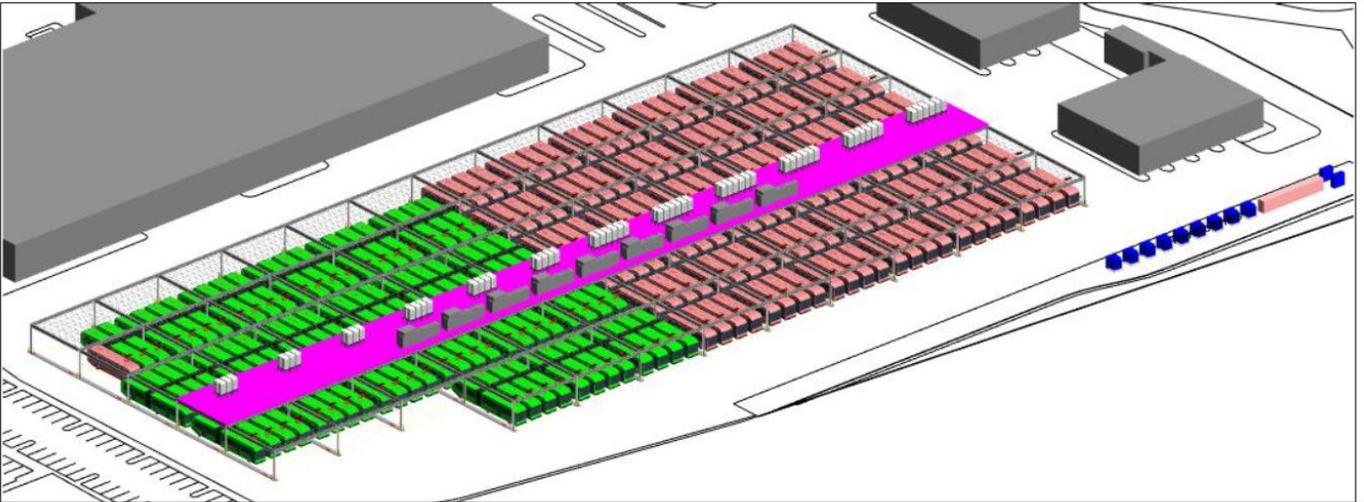
Example Overhead Charging System

# Powell Garage Site Plan



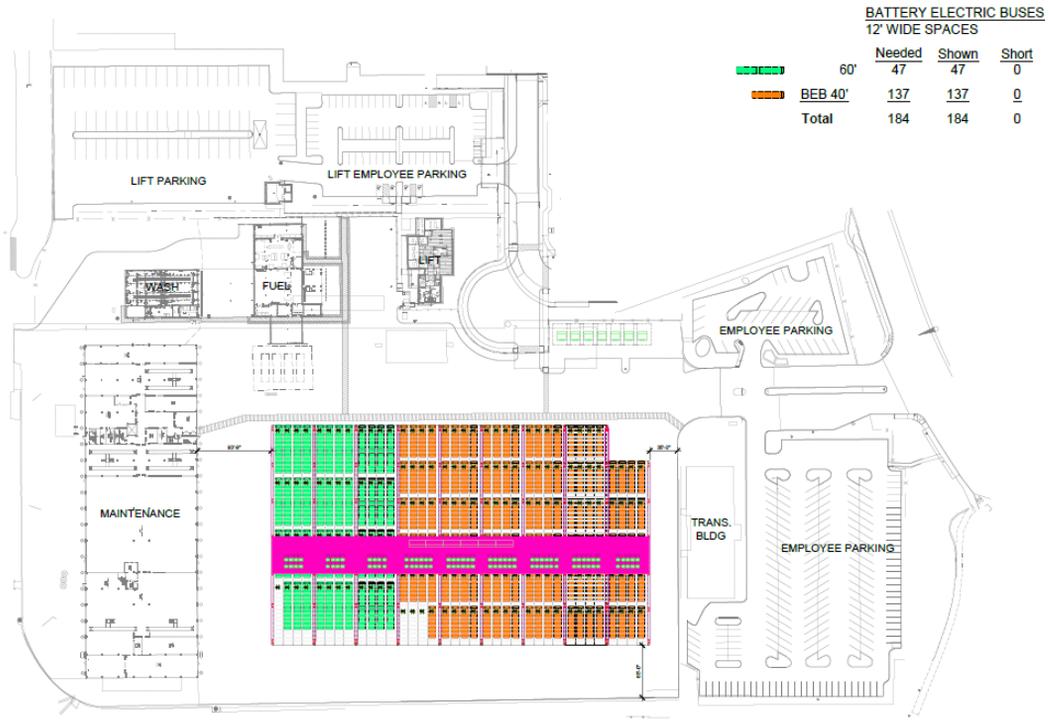
PROJECT NO.	0000A
DRAWN BY	BS
DATE	11/11/19
SCALE	AS SHOWN
PROJECT TITLE	TRIMET FACILITIES SYSTEM MASTER PLAN
DRIVER TITLE	TRIMET
ISSUED FOR REVIEW	WSP
DATE FOR REVIEW	11/11/19
PROJECT NUMBER	P.FBEX
DRAWING TITLE	POWELL BUS SITE PLAN 12' SPACE / 60 & 60-FOOT BEEB FLEETS W/ EXISTING BUILD

# Powell - Rendering



View from Northwest

# Merlo Garage Site Plan



DRAWING NUMBER	0000000000
	M.F.B
DRAWING TITLE	MERLO SITE PLAN
	12' SPACE / 40 & 60-FOOT BEB FLEETS
WSP	WSP CONSULTING 1000 N. 10TH ST. SUITE 200 DENVER, CO 80202 TEL: 303.733.8800 WWW.WSPCONSULTING.COM
	TRIMET
PROJECT TITLE	TRAM FACILITIES
	SYSTEM MASTER PLAN
PROJECT NO.	80804
DATE	7/27/2021
SCALE	1" = 100'
DRAWN BY	HR
DATE	7/27/2021
SCALE	1" = 100'

# Merlo - Rendering



# Center Garage Site Plan

**BATTERY ELECTRIC BUSES  
12' WIDE SPACES**

	Needed	Shown	Short
 BEB 60'	79	79	0
 BEB 40'	74	74	0
<b>Total</b>	<b>153</b>	<b>153</b>	<b>0</b>



DRAWING NUMBER <b>C.F.B</b>	DRAWING TITLE <b>CENTER BUS YARD 12' SPACE / 40' &amp; 60-FOOT BEB FLEET B</b>	 WSP GROUP, INC. 4000 WOODBURY WILLOW PARK, COLORADO 80110 TEL: 303.440.1100 FAX: 303.440.1104		PROJECT TITLE <b>TRIMET FACILITIES SYSTEM IMPROVEMENT PLAN</b>	SHEET NO. SHEET 1 OF 27
				PROJECT NO. DRAWN BY DATE SCALE	SHEET NO. SHEET 1 OF 27 DATE SCALE

# Columbia Garage Site Plan



## BATTERY ELECTRIC BUSES 12' WIDE SPACES

	Needed	Shown	Short
<span style="color: blue;">■</span> BEB 60'	108	108	0
<span style="color: orange;">■</span> BEB 40'	154	154	0
<b>Total</b>	<b>262</b>	<b>262</b>	<b>0</b>

1. ALL DIMENSIONS ARE IN FEET AND INCHES (DIMENSIONS IN PARENTS).  
 2. ALL DIMENSIONS ARE TO FACE UNLESS OTHERWISE NOTED.  
 3. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE NOTED.  
 4. ALL DIMENSIONS ARE TO CENTERLINE UNLESS OTHERWISE NOTED.

DRAWING NUMBER	PROJECT NO.	000004
	DRAWN BY	000000
DRAWING TITLE	DATE	000000
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DRAWING TITLE	PROJECT TITLE	TRIMET FACILITIES SYSTEM MASTER PLAN
		TRIMET
DRAWING TITLE	OWNER	TRIMET
	PROJECT NO.	000000
DRAWING TITLE	DATE	000000
	SCALE	1/4" = 1'-0"
DRAWING TITLE	PROJECT NO.	000000
	DRAWN BY	000000
DRAWING TITLE	DATE	000000
	SCALE	1/4" = 1'-0"
DRAWING TITLE	PROJECT NO.	000000
	DRAWN BY	000000
DRAWING TITLE	DATE	000000
	SCALE	1/4" = 1'-0"

# Upgrading Power

	<b>Estimated Future Maximum Power Consumption with a Fully Battery-Electric Fleet</b>
Powell	13.62 mW
Merlo	11.04 mW
Center	9.18 mW
Columbia	15.72 mW

# Maintenance Facility Upgrades

1. Fall protection
2. Overhead lifting capability
3. Charging units in garage



# Cost Estimates

(in \$2021, with contingency)

Garage	Charging Infrastructure	Maintenance Facility Upgrades	Total (\$2021)
Powell	\$166M	\$15M	\$181M
Merlo	\$128M	\$2M	\$130M
Center	\$112M	\$14M	\$126M
Columbia	\$195M		\$195M
Total for Garage Upgrades (base year)			\$632M
Total for Garage Upgrades (year of expenditure)			\$826M

# Zero Emissions Technology Options and Range Considerations

# Three Types of Zero Emissions Buses

## 1. Long Range Battery Electric Bus

- Typical range of up to 150 miles per charge
- Charge overnight at garage
- Example: TriMet's Gillig buses

## 2. Short Range Battery Electric Bus

- Typical range of ~50 miles per charge, unlimited daily range
- Charge overnight at garage AND during layovers
- Example: TriMet's New Flyer buses

# 3. Fuel Cell Electric Buses

- Operate similarly to diesel buses with hydrogen in place of diesel
- Range of up to 300 miles
- Require a source of hydrogen



# ZEB Types Comparison

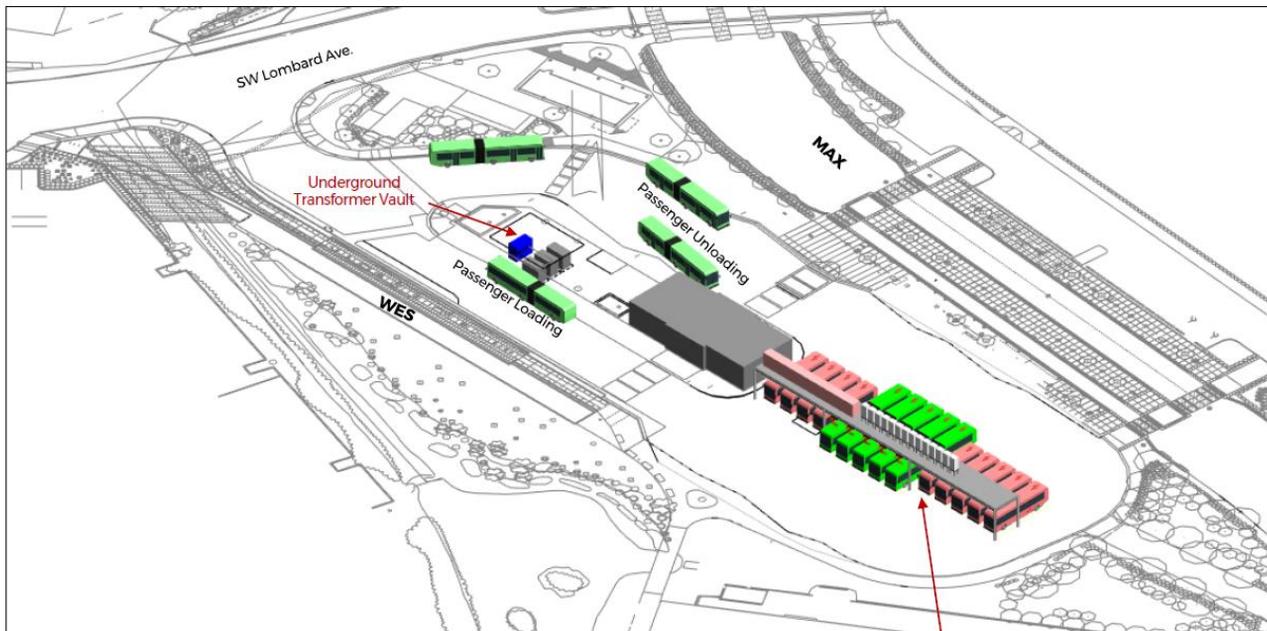
Long-Range BEB	Short-Range BEB	FCEB
+ lowest infrastructure cost	+ unlimited range	+ higher range + operations similar to diesel
- Limited range <i>(nearly 50% of TriMet buses operate more than 150 miles/day)</i> , would require more buses, larger facilities, and more drivers to operate same service	- High infrastructure cost - High operating cost (purchasing electricity at peak times)	- High infrastructure cost - High operating cost (cost of hydrogen)

# Short-Range BEBs and Opportunity Charging

- Initial modeling indicated need for fast chargers at 7 locations
  - Beaverton Transit Center
  - Gresham Transit Center
  - Clackamas Transit Center
  - Parkrose Transit Center
  - Gateway Transit Center
  - Tigard Transit Center
  - Pier Park

# Beaverton Transit Center

## Beaverton TC (Recommended Option)

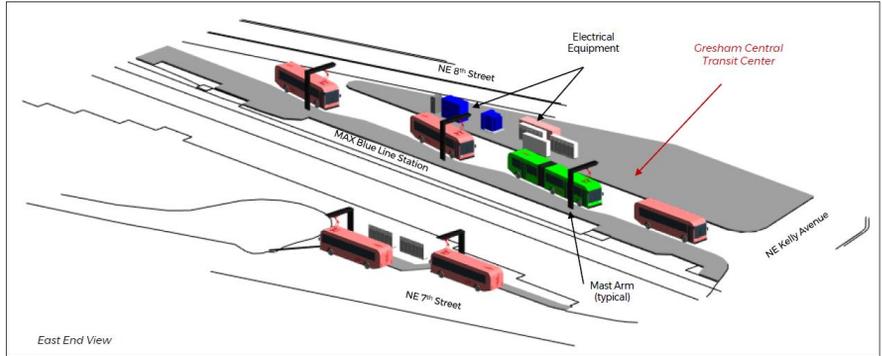


Bird's Eye View of Beaverton Transit Center

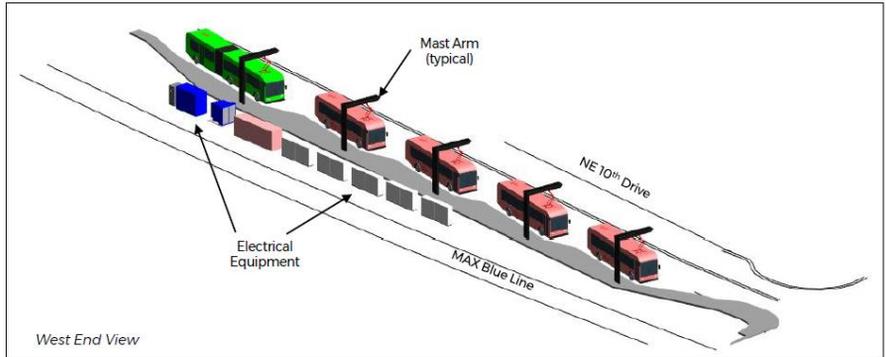
Bus Layover with Opportunity Charging

# Gresham Transit Center

## Gresham Central TC (East End)

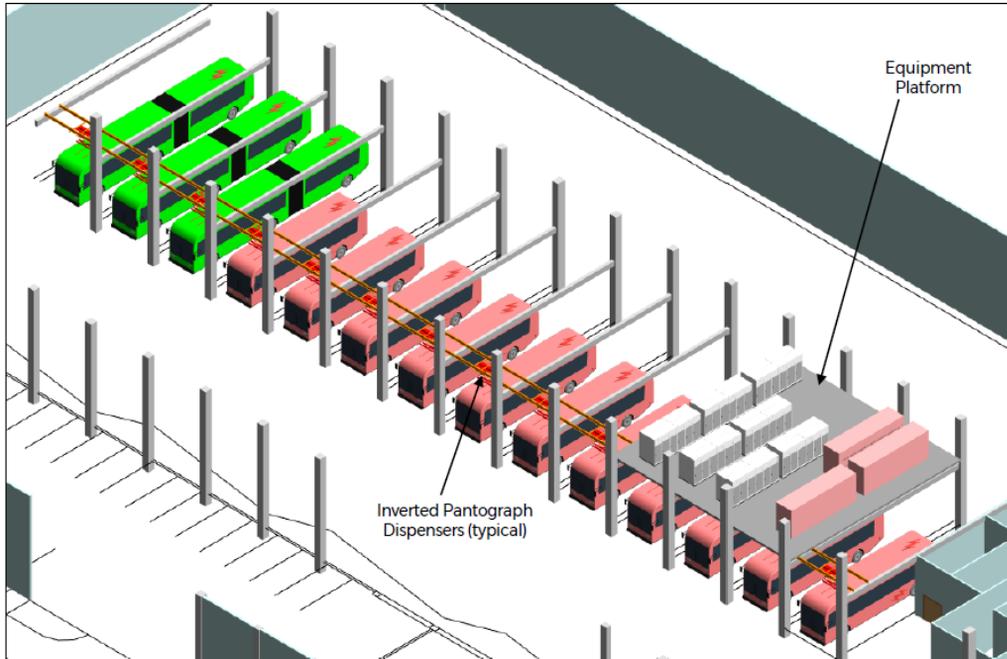


## Gresham Central TC - NE 10th Drive Layover (West End)



# Clackamas Town Center TC

## Clackamas TC



# Cost Estimates

(in \$2021, with contingency)

Site	Estimated Cost for Opportunity Charging
Beaverton	\$19M
Gresham	\$19M
Clackamas	\$16M
Parkrose	\$11M
Gateway	\$14M
Tigard	\$4M
Pier Park	\$8M
<b>Total in Base Year \$2021</b>	<b>\$92M</b>
<b>Total in Year of Expenditure</b>	<b>\$119M</b>

# Hydrogen Fueling

Example  
hydrogen bus  
fueling station  
in California



Photo credit: WSP

# Hydrogen Storage

## Liquid Storage



Liquid hydrogen storage tank

Photo credit: h2stationmaps.com

## Gaseous Storage



Photo credit: Eason Industrial Engineering,  
<https://www.easonindustrial.com/>

# Hydrogen Generation

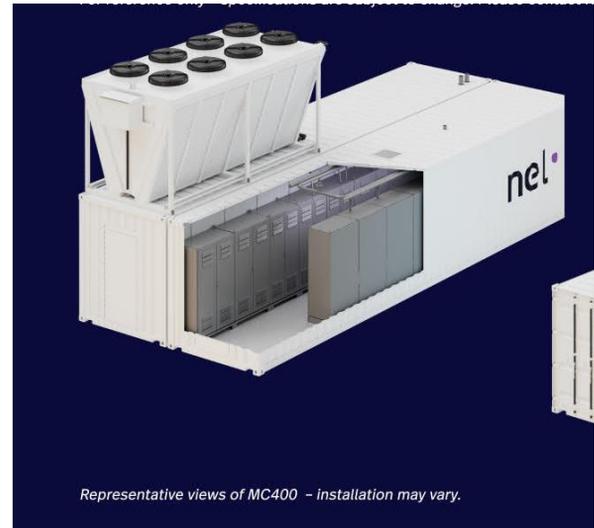
Steam Methane  
Reformer (gas)



Source: Linde



Electrolyzer (water)



*Representative views of MC400 - installation may vary.*

Source: Nel

# Nearest Options for Sourcing Hydrogen

- Sacramento, CA  
– Air Products
- Las Vegas, NV –  
Air Liquide
- Douglas  
County, WA (in  
construction)



Source: energy.gov

TriMet would need 4-5 truck deliveries per day

# Hydrogen Alternatives Analyzed

	Description	Conclusions
1	Produce hydrogen at Columbia Bus Base and distribute to other facilities	- Not feasible; requires a specialized fleet and workforce for delivery trucks
2	Produce gaseous hydrogen at each facility	- Very high capital cost and real estate requirements
3	Purchase liquid hydrogen from offsite	- Likely the best choice if a local source becomes available

# Estimated Capital Costs

Alternative	Capital cost (\$2021) of infrastructure to support 2040 bus volumes
2: Produce hydrogen	\$440M
3: Purchase hydrogen	\$53M

# Summary of Capital Costs

- Garage upgrades = \$632M
- Opportunity charging = \$92M OR  
Hydrogen fueling = \$53M

Total Infrastructure Need = \$685-724M  
(in \$2021)

# Next Steps

- Initiating next procurement of BEBs
- Air quality modeling and clean corridors plan
- Continued long term planning and design for bus garages

# Meeting Adjourned