Stantec

ROARING FORK TRANSPORTATION AUTHORITY

Zero Emission Vehicle (ZEV) Transition Plan

APRIL 11, 2024

Presentation Overview

1. Project Purpose & Recap
2. Existing Conditions – Key Findings
3. ZEV Modeling and Findings
4. Cost of Ownership Analysis
5. Evaluation Criteria and Screening
6. Recommended Alternative
7. Discussion

PROJECT PURPOSE & RECAP

Background - State ZEV/EV Policy

Climate Action Plan (House Bill 19-1261)

- Establishes statewide GHG emissions reduction goals of 26% by 2025, 50% by 2030 and 90% by 2050 (2005 baseline)

Colorado 2023 EV Plan

- 1,000 ZEV Transit Vehicles by 2030
- 100% ZEV by 2050

Colorado Transit ZEV Roadmap

- Reaffirms ZEV transition goals and strategies for Colorado transit agencies
- Foundation for the development of the Clean Transit Enterprise Ten-Year Plan

Clean Transit Enterprise

- The Clean Transit Enterprise in Colorado supports the electrification of public transit through planning, site upgrades, procurement of electric transit buses, and the development of associated charging infrastructure. Provides funding for battery electric, plug in hybrid electric and hydrogen fuel cell vehicles (and RNG under certain circumstances).

Future Clean Transit Rule (Colorado 2023 EV Plan & Clean Truck Strategy)

- Action to investigate the adoption of a Clean Transit Rule that would require a long-term transition to zero emission transit vehicles

RFTA Background & Policy

2019 RFTA-City of Aspen BEB Pilot Project

- RFTA began operating 8 BEBs

RFTA Destination 2040 Plan

- Desired fleet of 1/3 diesel, 1/3 CNG and 1/3 ZEV by 2040

RFTA Climate Action Plan

- Reduce scope 1 and 2 GHG emissions 50% by 2030 and 90% by 2050
- Reduce transportation-related emissions throughout the region by increasing emissions offset compared to emissions produced in 2019 to 3x by 2030 and 5x by 2050.
- Key Strategy Categories
    - Emissions from Fleet
    - Emissions from Facilities
    - Emissions Displaced by Transit

Project Overview

DEFINE Technology Mix and Year-to-Year Composition

Revenue fleet, including paratransit and support/admin fleet

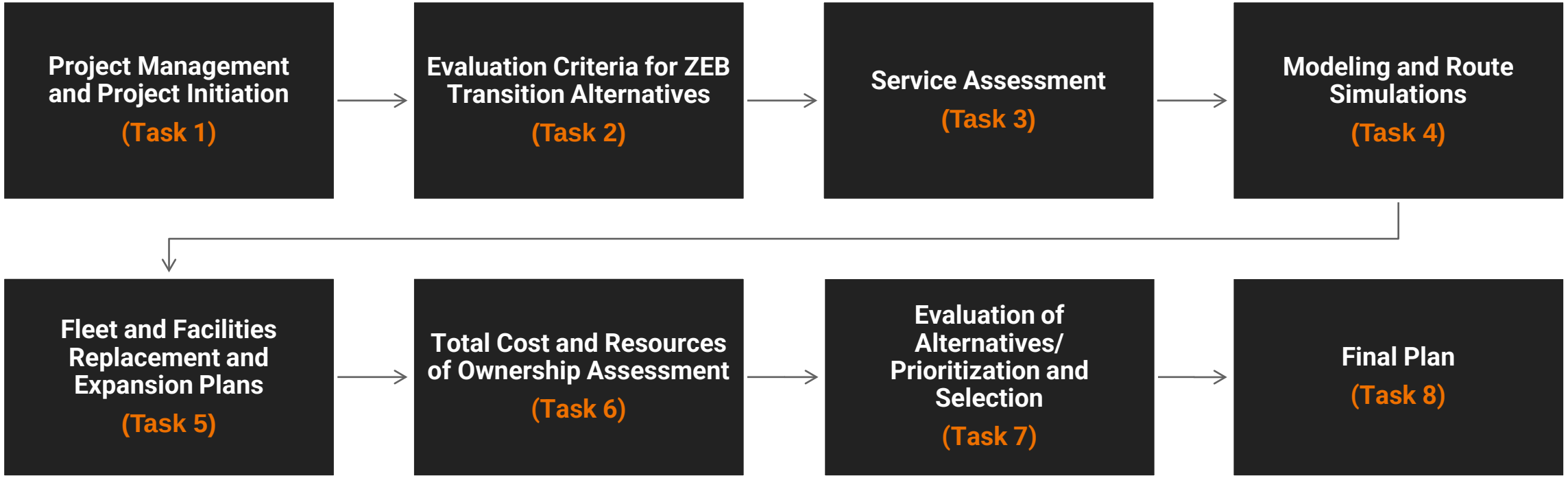
DETERMINE ZEV Infrastructure Upgrade and Timeline

GMF, AMF, and potential on-route charging locations

ASSESS Operational Changes and Cost of Ownership

Buses, existing and proposed ZEV support infrastructure

Project Approach



EXISTING CONDITIONS – KEY FINDINGS

Current Revenue Fleet

Mix of fixed-route local, fixed-route commuter, BRT, and demand-response services.

22	4	5	87	27	FUEL TYPES
Cutaways (Ford)	29-30-ft buses (Optima, Gillig)	35-ft. buses (Gillig).	40-ft buses (Newflyer, Gillig, New Flyer, Excelsior -**8 BEB**).	45-ft. motor coaches (MCI).	Gasoline, diesel, CNG, and electric.

Support vehicles are also considered as part of the transition analysis

TOTAL VEHICLE (INCLUDES ACTIVE PREP AND SURPLUS)

145

ACTIVE VEHICLES AS OF SEP'23

117

AVERAGE VEHICLE AGE (YEARS)

8

Maintenance Facility – GMF/RTC

Functions:
Admin, Maintenance
Operations, Fuel-wash

Upgrades underway:

- New bus-storage canopy
- New wash bays
- Space for future hydrogen fueling and storage

Transition Requirements:
BEBs:

- electrical upgrades
- chargers
- generators
- fall protection, etc.
- additional storage for vehicles and equipment

FCEBs

- hydrogen storage/fueling equipment
- gas leak and flame detection
- additional storage for vehicles and equipment

Maintenance Facility - AMF

Existing BEB Chargers

Functions:
Maintenance, Operations, fuel, wash

Upgrades completed from 2014 to 2019:

- Fuel island and wash lane replacement
- Electric bus charging stations
  (four, dual-port pedestal Level 2 chargers).

Transition Requirements:
BEBs:

- electrical upgrades
- additional chargers
- additional generators
- fall protection, etc.
- additional storage for vehicles and equipment

FCEBs

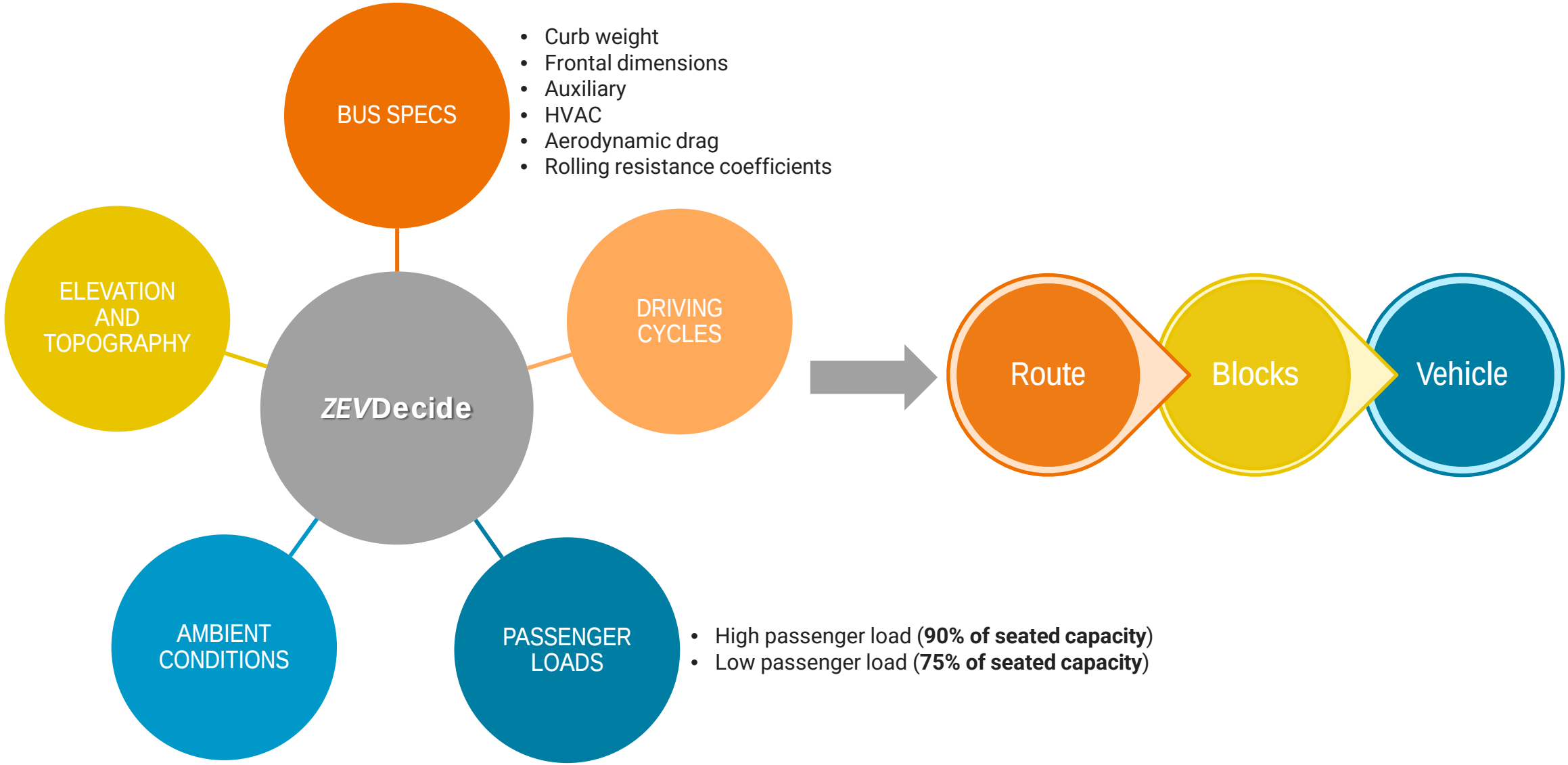
- new hydrogen storage/fueling infrastructure
- major ventilation system updates
- gas leak and flame detection
- electrical upgrades
- additional storage for vehicles and equipment

Existing Conditions
Key Observations

- RFTA operates a **mix of fixed-route and demand-response** services.
- Fixed route blocks run between **16 and 496 miles** per day.
- Demand-response cutaways run an average of **64 miles** a day.
- **Limited capacity** for growth at the current **AMF**
- **GMF is currently undergoing upgrades** that will help accommodate the transition to ZEBs

ZE MODELING AND FINDINGS

Modeling Process Overview



Bus Specifications

BEB Model	Electric Cutaway	Electric 30' Bus	Electric 35' Bus	Electric 40' Bus	Electric Motorcoach
Battery (kWh)	120	350	450	525	544
Curb Weight (lbs.)	14,500	29,700	29,700	45,000	47,000
Service type(s)	DR, Fixed Route	Fixed Route	Fixed Route	Fixed Route	Fixed Route

FCEB Model	Hydrogen Cutaway*	Hydrogen 30' Bus*	Hydrogen 35' Bus	Hydrogen 40' Bus	Hydrogen Motorcoach*
Tank (kg)	13.5	37.5	37.5	50	50
Curb Weight (lbs.)	16,500	29,700	29,700	45,000	47,000
Service type(s)	DR, Fixed Route	Fixed Route	Fixed Route	Fixed Route	Fixed Route

**Hydrogen cutaways, 30' buses, and motorcoaches are not currently commercially available.*
***Electric cutaways and motorcoaches currently do not have commercially available on-route charging options.*

Bus Specifications

BEB MODELS

Cutaways

30’ Buses

35’ Buses

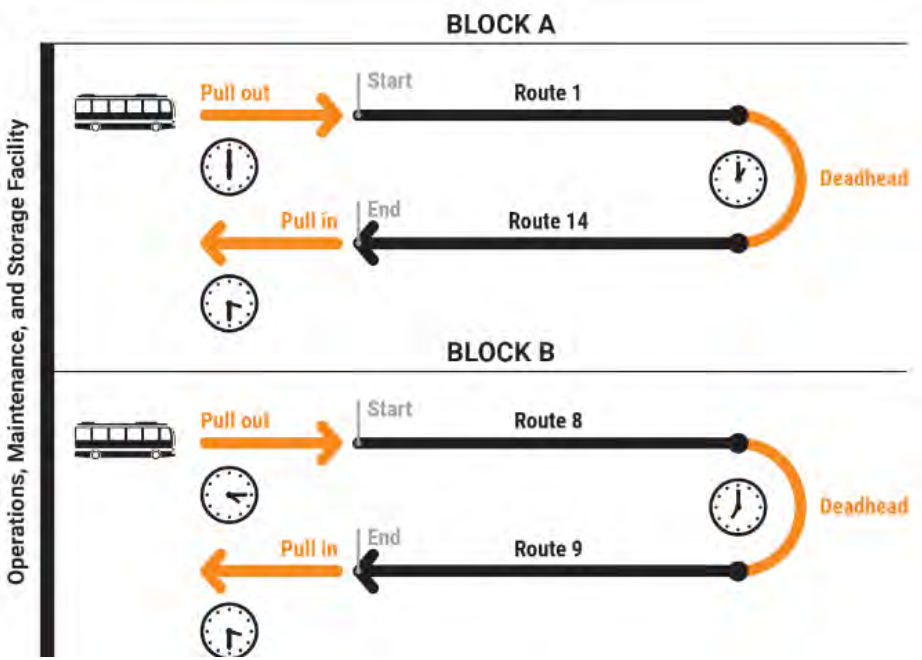
40’ Buses

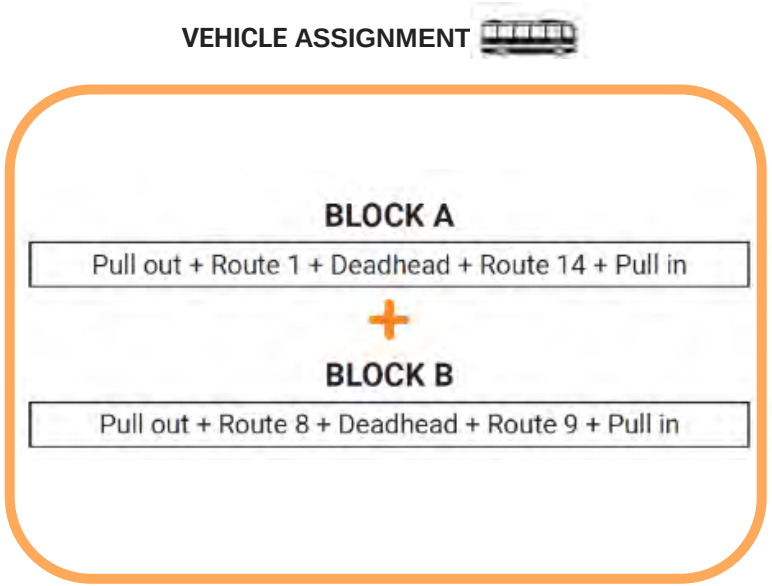
Coach 45’ Buses

FCEB MODELS

**Hydrogen cutaways, 30’ buses, and motorcoaches are not currently commercially available*
***Electric cutaways and motorcoaches currently don’t have commercially available on-route charging options*

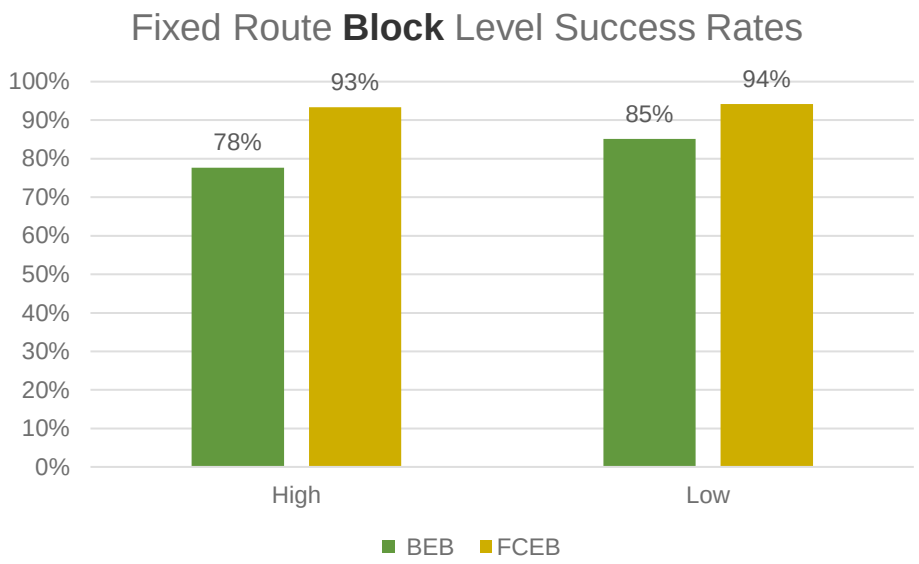
Modeling Inputs at the Block and Vehicle Level

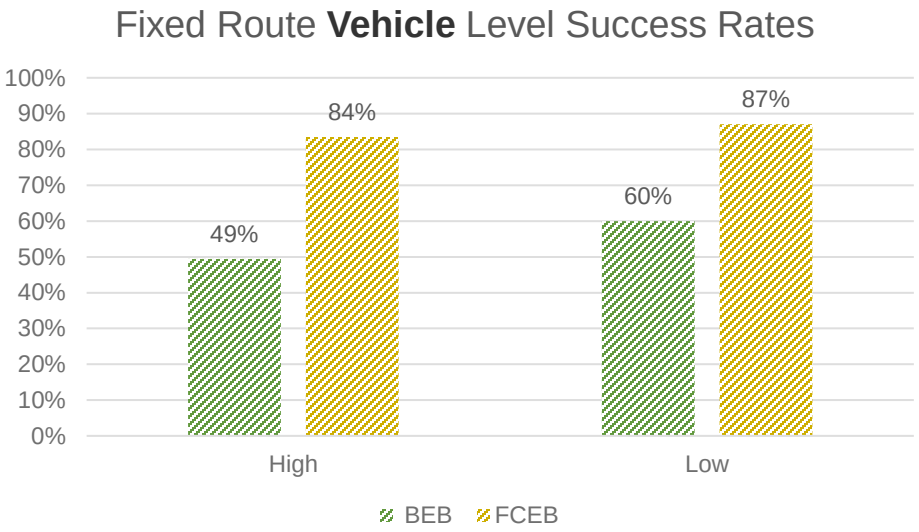




- Success of ZEB technology at the block level is critical to minimize operational impacts such as fleet size and labor force increases
- Success of the modeled ZEB technology at the vehicle level is desired but can be mitigated with changes in dispatch process

Modeling Summary





- FCEBs have longer range therefore more successful outcomes compared to BEBs
- Neither technology provides 100% success with current vehicle sizes and blocking
- 69% of modeled Dial-a-Ride services were successfully completed by BEBs. And 96% of modeled Dial-A-Ride services were successfully completed by FCEBs
- **Fleet and/or blocking changes are required with either technology in order to successfully transition to ZEBs**

Analysis Cases

01 Timeline

Accelerated Transition by (2040)

- ✓ higher cumulative GHG reduction
- ✓ higher cumulative costs

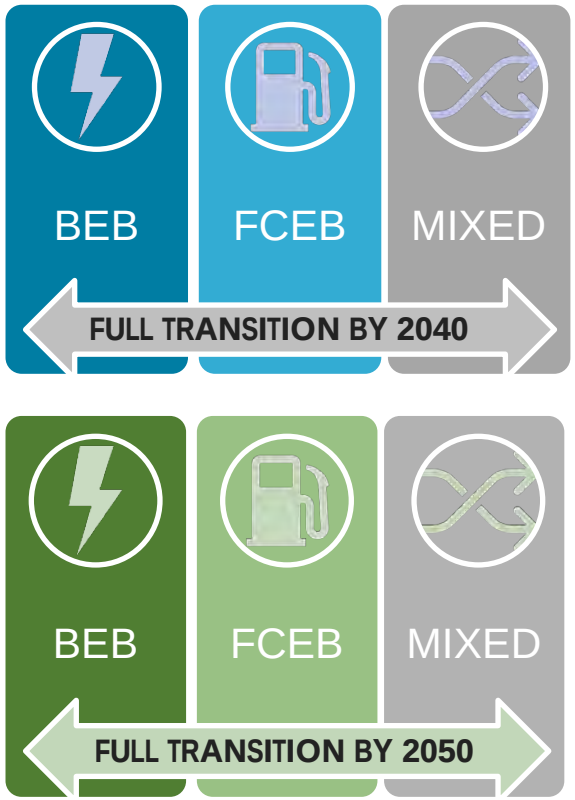
Transition by (2050)

- ✓ lower cumulative GHG reduction
- ✓ lower cumulative costs

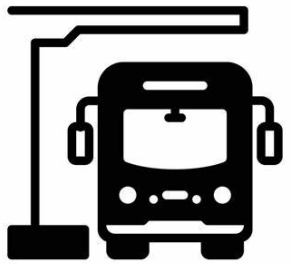
02 Technology Type

1. **BEB Only**
2. **FCEB Only**
3. **Mixed**
   - ✓ maximizes the operational strengths of various technology types and their fit to RFTA's operations

03 Six Analysis Cases



BEB Modeling



1.1 On-route charging is required to address the long block distances in existing operations (21 blocks)

1.2 Three on-route chargers will be needed at Rubey Park and three additional ones at West Glenwood Springs Park and Ride lot to support operations.

1.3 Assumes midday charging during layovers at the GMF and AMF

2.1 Re-blocking or vehicles with larger batteries are needed for 4% of the blocks in 2040 (5 blocks)

2.2 Limits the current flexibility to assign vehicles to more than one block in a day on an arbitrary basis

3.1 Requires an increase in active vehicles for demand response and COA routes serviced by cutaways.

FCEB Modeling

1.1 Assumes midday re-fueling at GMF and AMF between blocks (4 blocks)

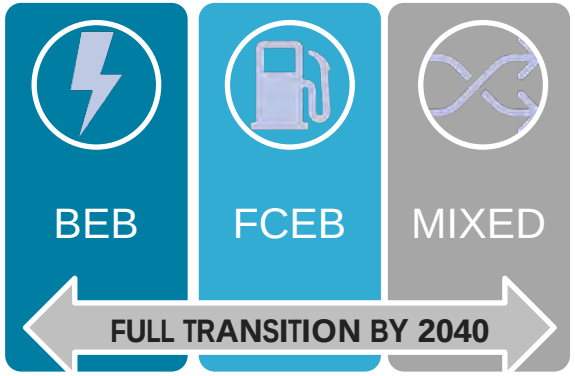
2.1 Re-blocking or vehicles with larger tanks are needed for only 2.5 % of the blocks in 2040 (3 blocks)

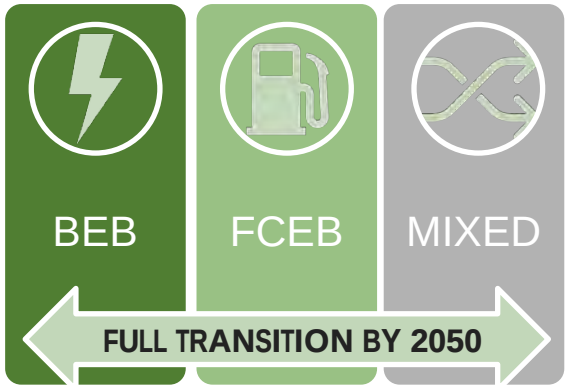
2.2 Allows demand response services and COA cutaway routes to operate with minimal changes from existing service

3.1 Major capital investments at AMF needed for safety improvements and upgrades that are needed to allow CNG and FCEB maintenance and storage on-site (mechanical systems such as ventilation and gas detection systems)

COST OF OWNERSHIP ANALYSIS

Cost of Ownership Analysis





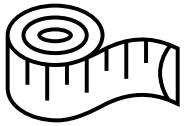
STEPS

1) Collected relevant financial data on current operations
2) Determined financial model inputs in collaboration with RFTA staff
3) Projected annual costs 2023-2050
4) Compared cumulative costs between the six analyzed cases

LIMITATIONS

1) The cost categories modeled are focused on the impacts of a change in propulsion type
2) This analysis is meant to be a comparison between the different scenarios and not a detailed capital and operational forecast for RFTA

Cost of Ownership Assumptions and Inputs



COST CATEGORIES

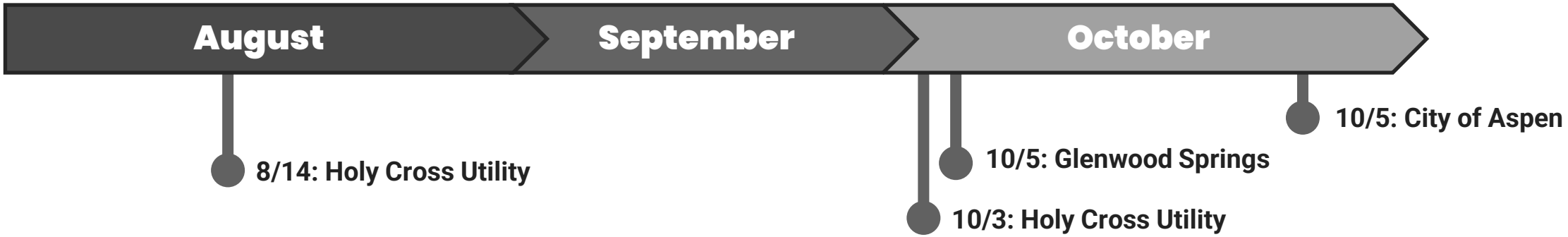
Fleet Acquisition	Fuel/Energy	Maintenance	Refurbishment	Infrastructure
❑ Fleet Replacement Plan	❑ Fleet Annual Fuel/Energy Consumption	❑ Fleet Annual Miles travelled by vehicle type	❑ Fleet Annual Refurbishments by vehicle type	❑ ZEB charging/fueling equipment and installation
❑ Vehicle Costs	❑ Fuel/Energy Costs	❑ Maintenance Costs by vehicle type	❑ Refurbishment Costs by vehicle type	❑ Costs for charging/fueling equipment

DOES NOT INCLUDE:

- Service delivery costs (such as driver/mechanic salaries) assumes those will be comparable in all scenarios(cases)

- Maintenance bays retrofits/mechanical modifications to meet codes related to ventilation and gas detection systems.

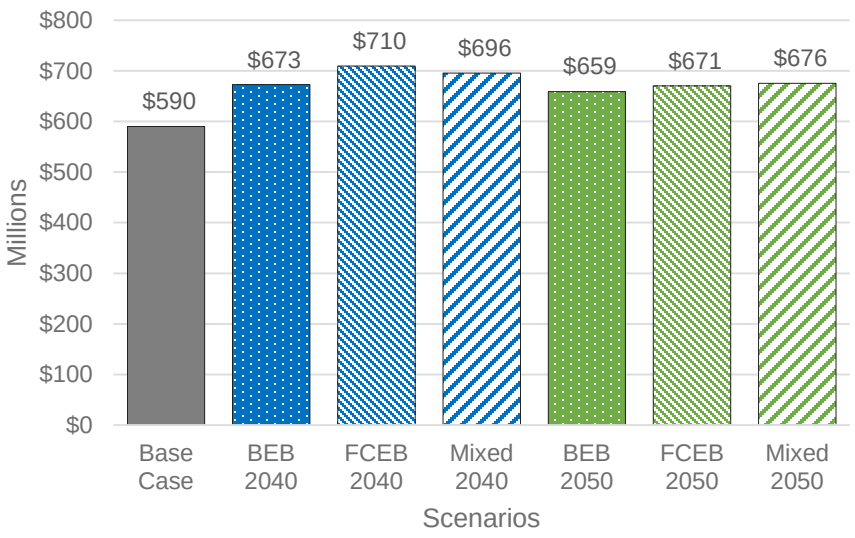
Utility Coordination Meetings



Common Meeting Topics

- Discussion of Electric Rate Structures and options
- Utility upgrades, RFTA upgrades, Make-Ready Incentives
- Funding Strategies (on-bill financing, Federal funding)
- ZEV Strategies (on-route charging, charging strategies)
- Exploring Hydrogen Fuel options and “Green” Hydrogen

Cost of Ownership Summary Results



Analysis Period:
Costs are cumulative for the period 2023-2050

Base Case:
Follows the Destination 2040 Plan
with programed 29% BEBs by 2032

2040 ZEB Cases have higher costs due to:

- Earlier procurement of vehicles
- More ZEB vehicles are procured during the analysis period
- Charging infrastructure replacement occurs

1	BEB 2050 Case ($659 million)	Estimated to be 12% higher than the base case.
2,3,4	FCEB 2050 Case ($671 million) BEB 2040 Case ($673 million) Case. Mixed 2050 Case ($676 million)	Estimated to be 14%-15% higher than the base case

EVALUATION CRITERIA AND SCREENING

Evaluation Criteria

RFTA staff selected and weighted **Seven Base Criteria** (June 2023) via:

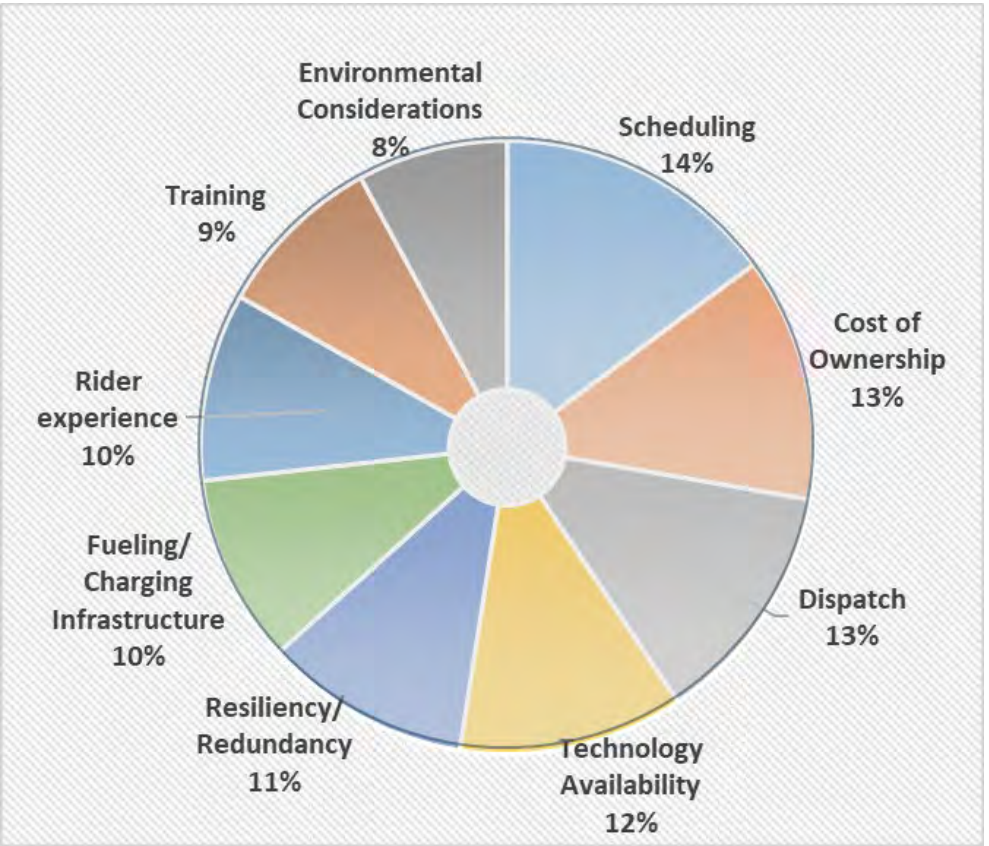
- Online survey
- In-person workshop

Two additional Base Criteria added:

- As further discussions were held with the RFTA staff and internal stakeholders (Environmental Considerations and Rider Experience)

Stantec Evaluated with RFTA staff **Forty-Nine Sub-Criteria** :

- Final evaluation workshop review (February 2024)



Evaluation Sub-Criteria Example

Base Criteria

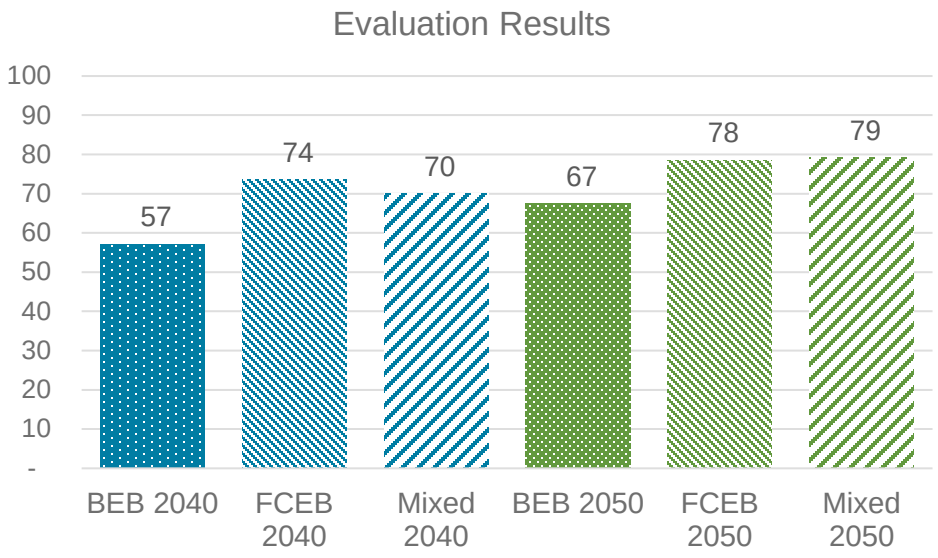
Sub-Criteria

Technology Availability/ OEMs/Procurement	BEB	FCEB	Mixed
	2050		
Base score	100	100	100
Availability of a 45ft FCEB and 45ft with on-route charging			
Number of different OEMs offering vehicle types needed by			
Complexity of procurement and warranty agreements			
Integration of IT technology requirements			
Adaptability by diversification			
Update of O&M contracts (Union restrictions)			
Total score	70	70	85

Qualitative criterions (Sub-Categories) Scoring:

Highly critical	-15
Medium critical	-10
Low critical	-5
No reductions	0

Evaluation Results



Preferred Fleet: 2050 Mixed Case

- Mixed Case received highest score when considering all nine evaluation criteria
- Benefits from diversification increased the Mixed Case relative scoring
- FCEB Case scoring weighed down by risks associated with hydrogen availability and distribution

Mixed 2050 Case (79)

Has the highest score

FCEB 2050 Case (78)

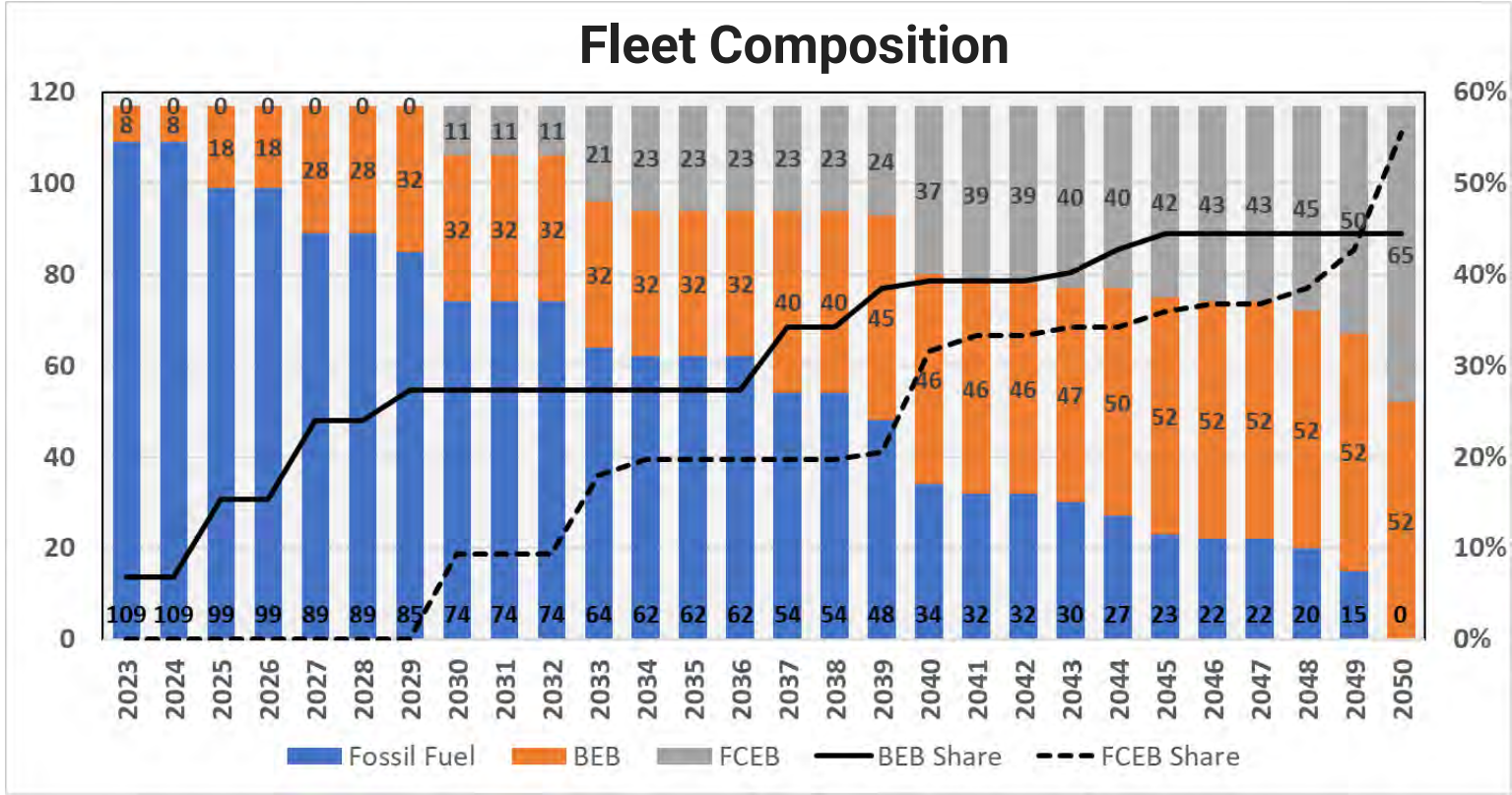
FCEB 2040 Case (74)

Mixed 2040 Case (70)

Have a close score to the preferred scenario

RECOMMENDED ALTERNATIVE

Mixed Case Full Adoption by 2050



2023
109 fossil fuel (FFs) buses and 8 ZEBs

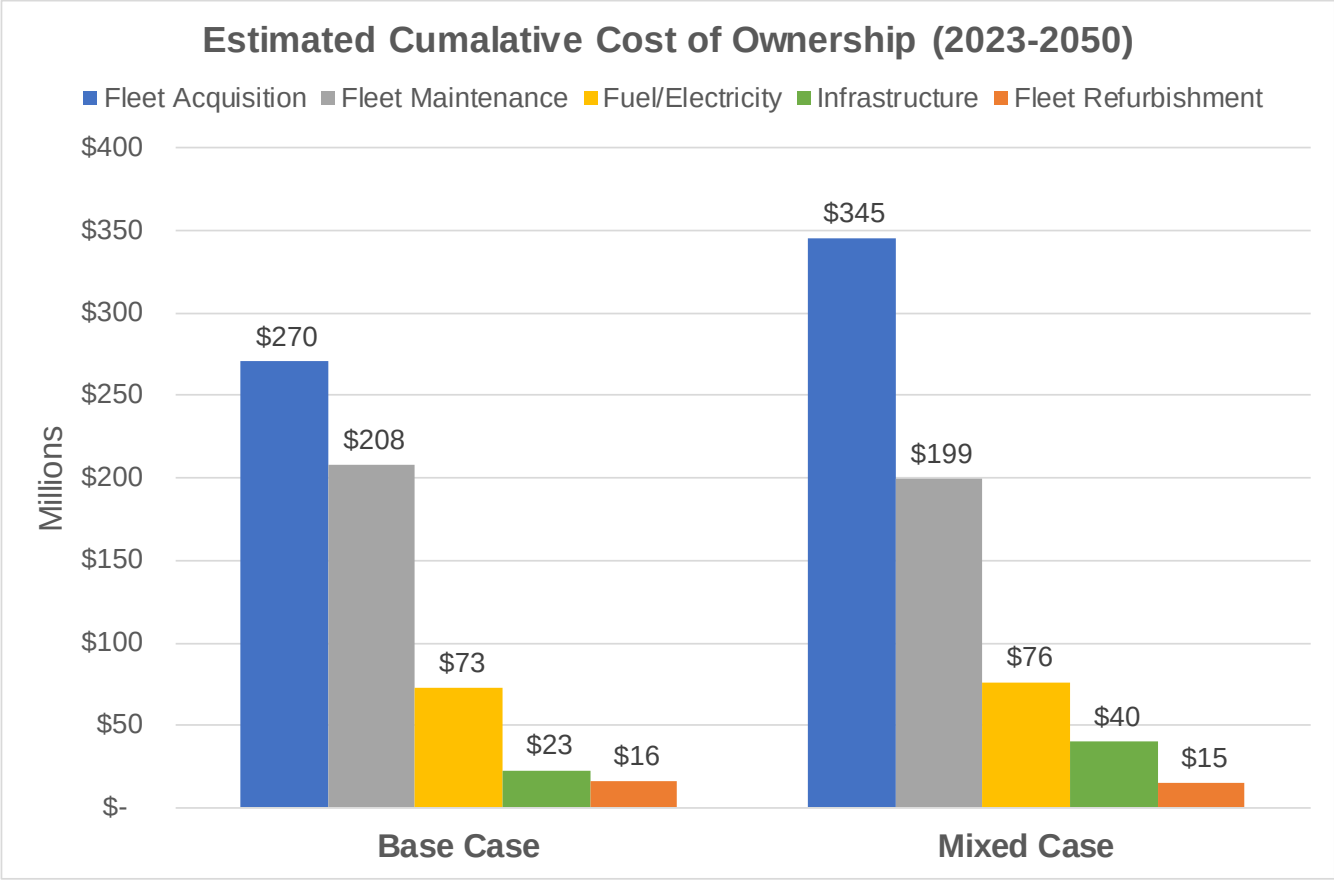
2050
0 FFs, 52 BEBs (44%) and 65 FCEBs (55%)

40-ft and 30-35-ft buses
Transition first

45-ft coach buses
Transition later as more options for BEB coaches with on-route charging, and FCEB coaches are expected in the future

Cutaways
Transition last since technology has limited ranges

Mixed Case Full Adoption by 2050



Estimated Savings for:

- Fleet Maintenance
- Fleet Refurbishments

Estimated Higher Costs for:

- Fleet Acquisition
- Fuel/Electricity
- Infrastructure

Mixed Case 2050 SWOT

Internal Origin

Helpful

Harmful

External Origin

STRENGTHS

- ✓ Utilizes current investments of the already planned BEB fleet and charging equipment
- ✓ Leans on FCEB technology to cover longer ranges which reduce operational changes
- ✓ Provides the highest operational flexibility to RFTA

WEAKNESSES

- ✓ Complexity of operating and maintaining two ZEB technologies
- ✓ Maintenance and fueling for FCEBs exclusively at GMF

OPPORTUNITIES

- ✓ Diversified energy/fuel sources
- ✓ Allows a smooth pivot if one technology outpaces the other
- ✓ Allows for both technologies to mature until they can satisfy operational needs

THREATS

- ✓ By investing in two ZEB technologies, slightly higher costs are expected and potential for economy of scale is underutilized
- ✓ Hydrogen supply chain can take longer to mature in the region

Questions?

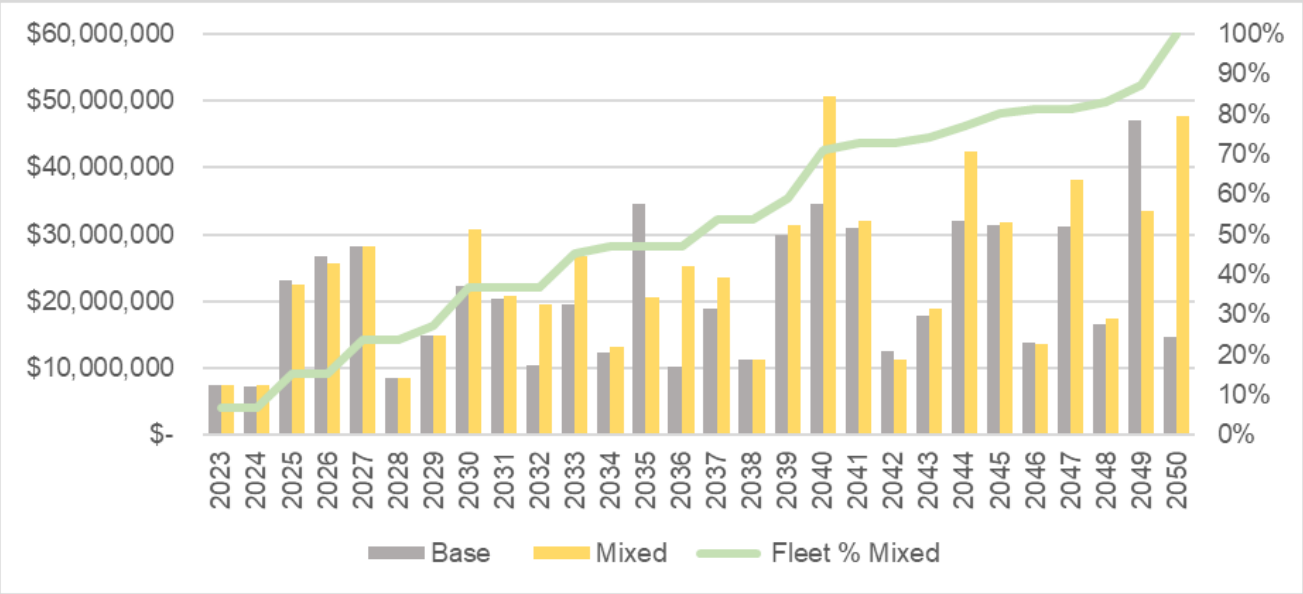
Support Slides

Utility Coordination – Opportunities & Next Steps

- On-going strategic planning for ZEV Transition
- Exploring opportunities for collaborative investment and planning
- Mutually beneficial opportunities to align strategies to meet RFTA service needs and optimize utility resource planning and grid management
- Pilot/test and develop ZEV rates
- Facilitate strategic coordination between utilities to identify strategies to meet RFTA needs

Mixed Case Full Adoption by 2050

Estimated Annual Cost Comparison Base vs Mixed Case Full Adoption by 2050



Estimated Mixed Case Full Adoption by 2050 Total Cost of Ownership (2023-2050)

	Mixed 2050 Scenario			
Cost Components	Estimated Base Case	Estimated Mixed Case	Estimated Savings	Estimated Cost difference (Mixed - Base)
Fleet Acquisition	$ 270.5	$ 345.4	$ (74.9)	$ 74.9
Fleet Refurbishment	$ 16.3	$ 15.2	$ 1.1	$ (1.1)
Fleet Maintenance	$ 207.6	$ 199.1	$ 8.5	$ (8.5)
Fuel/Electricity	$ 72.8	$ 76.1	$ (3.3)	$ 3.3
Infrastructure	$ 22.9	$ 39.8	$ (16.9)	$ 16.9
Total	$ 590.0	$ 675.6	$ (85.7)	$ 85.7

FCEB at GMF

2032 Phase 1
(infrastructure, generator, and fueling island)
2040 Phase 2
(redundancy equipment)

BEB at AMF

2025 – 16 chargers(plugs) (8 existing and 8 planned)
2027 – Phase 1 (new transformer, conduit, backup generator and 4 chargers(plugs))
2035 – Phase 2 (13chargers(plugs))

On Route Charging

Rubey Park – 1 existing + 2 new chargers
West Glenwood P&R – 3 new chargers