CITY COUNCIL AGENDA
February 27, 2024

CitySpace, 100 5th St. NE
5:00 PM

Juandiego R. Wade, Mayor
Brian R. Pinkston, Vice Mayor
Natalie Oschrin
Michael K. Payne
J. Lloyd Snook, III
Kyna Thomas, Clerk

Call to Order/Roll Call

WORK SESSION

1. Report: Alternative Fuels Study

Public Comment

Adjournment

City Council Work Session

Review of Recommendations – February 2024

Topics/Agenda

- Review Alternative Fueled Bus Recommendations and Goals
- Office of Sustainability
- Neighborhood Development Services
- Council Discussion

Alternative Fueled Buses – Fleet Transition Recommendation

Recommendations

1. CAT will transition to a zero-emissions fleet by 2040, supporting the City's climate goals of carbon-neutral operations by 2050
2. CAT will pilot to two fuel types for transition: battery-electric and hydrogen fuel cell
    1. The BEB pilot will begin with 2 BEBs being purchased in 2024.
    2. Hydrogen fuel cell pilot vehicles will be purchased in 2027
    3. BEB pilot testing will come before hydrogen pilot testing, so there is sufficient time to establish a source for a hydrogen supply or generation.
3. During pilot testing, CAT will continue expanding its fleet to meet the capital requirements of planned service improvements

Recommendations Cont.

4. The final fleet mix will be determined through pilot testing and improvements to ZEB technologies. CAT's chief consideration will be the fleet's reliability and capital and O&M costs

5. Charging and fueling will take place at the CAT facility
   - The City will identify a source for hydrogen fuel and investigate on-site green hydrogen production as part of the site planning effort.
   - The City will investigate on-site generation of electricity for the charging of BEBs at the CAT facility as part of the site planning effort

Project Goals

- Determine a preferred cleaner fuel type for CAT
- Determine high level implementation strategy and timeline of the preferred fuel type
- Achieve **45%** GHG reduction by 2030; net zero by **2050**
- Build a fleet to support CAT's expansion over the next 10 years

Office of Sustainability

Update/Comments/Recommendations

Topics

- Climate Context
- Health & Climate Assessment
- Advocacy Community Input
- Hydrogen & ZEB Technologies
- Recommendation

Charlottesville's Greenhouse Gas Emissions are approximately:

95% Community

5% Municipal

RESIDENTIAL GHG

30%

COMMERCIAL GHG

30%

TRANSPORTATION GHG

30%

WASTE GHG

5%

Health & Climate Assessment

- A byproduct of the operation of motor vehicles is the emission of gases and particulate matter which affect the environments where released.

Carbon Monoxide (CO)	Sulfur Oxides (SO_x)
Greenhouse Gases (GHGs)	Volatile Organic Compounds (VOCs)
Nitrogen Oxides (NO_x)	Particulate Matter (PM)

- All alternative fuel transition scenarios reduce CAT's GHG emissions
- A BEB or FCEB transition would eliminate and/or reduce local emissions of air pollutants
- A natural gas bus transition (CNG or RNG) from diesel buses would reduce many local air pollutants *but would result in a ten-fold increase in local CO emissions.*
- Consideration of global and local environmental impact

Supply chain-related (e.g., lithium mining, methane leaks)	Electric grid transition (100% clean electric grid by 2050)
Local air quality	Noise levels

Climate Context

- 2019 - Charlottesville adopted climate goals of 45% reduction by 2030 and carbon neutrality by 2050
- 2022 – CAT engages Kimley-Horn to conduct an Alternative Fuels Feasibility Study
  - PW/Environmental Sustainability (now Office of Sustainability) requested and funded a study addendum to evaluate the climate and health implications of transitioning the current CAT fleet to an alternatively-fueled option.
- 2023 – Charlottesville adopts the Community Climate Action Plan

CHARLOTTESVILLE
Acting on Climate Together

Transportation Sector

Sub-goal: Increase transit ridership

Key Strategy in Municipal Transportation Section: Plan and Support Transition to Zero-Carbon and Carbon-Neutral Sources for the City's Mobile Assets

Transit Focus

- Key Action: Complete the Transit Alternative Fuels Transition Study, including the Environmental/Health Addendum
- Key Action; Initiate a Transit Pathways to Carbon Neutrality by 2050 Assessment

Advocacy Community Input

- Community organizations, community members (including many students) have provided comments over the past 2+ years
  - Overall - largely in support of zero-emission buses (ZEBs)
  - Generally – emphasizing the critical climate action component of this work
  - Specifically – responding to the outcomes and recommendations of the study
- Input has come in many forms
  - Public comment
  - Advocacy campaigns (including petitions)
  - Emails to City Council and leadership
  - Song
  - Media interviews
  - Opinion Editorials

Advocacy Community Input

Community Climate Collaborative (C3)

- 2020-2021 – Transit Equity and Climate campaign
- 2022 – *Accessible, Clean Transit petition* submitted to City Council; included a goal to Reduce Air and Climate Pollution from our Transit System
- 2023 – Alternate Fuels Report
- 2023 – Submitted *Community Letter on Alternative Fuel Buses* City Council in support of ZEB adoption, emphasizing benefits to both local air quality and global climate.

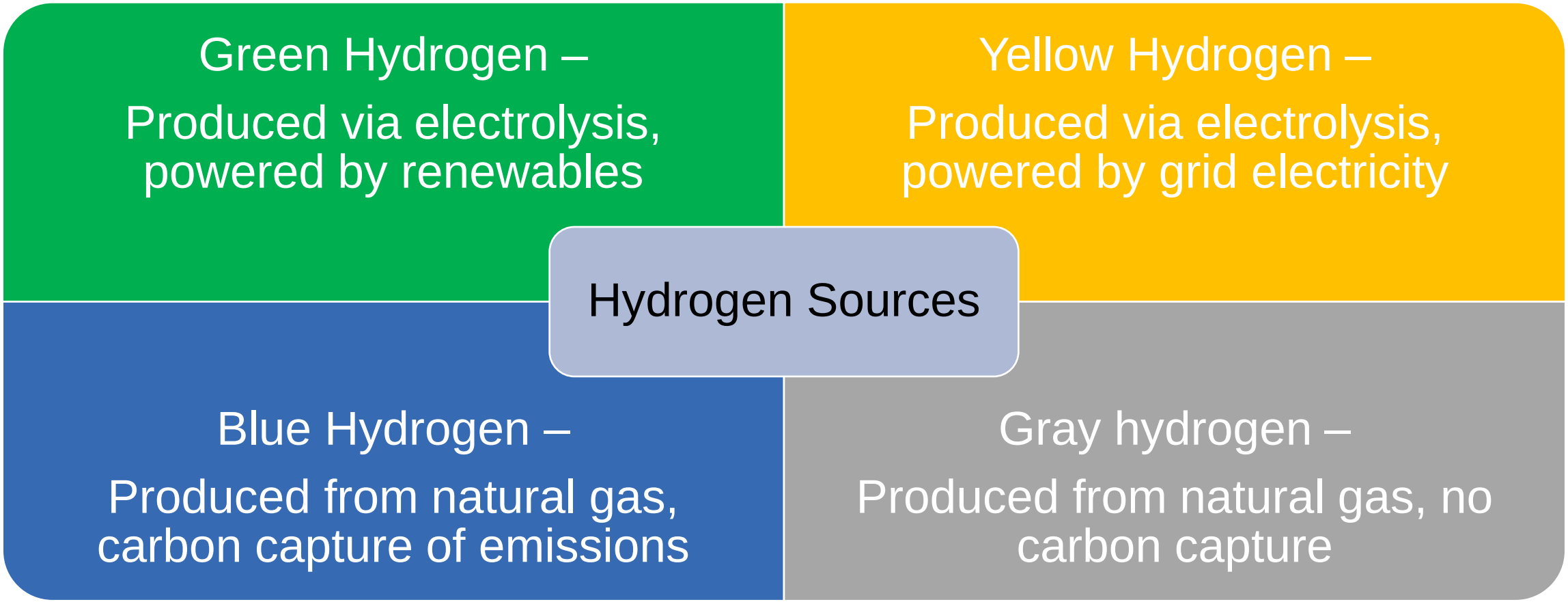
  (co-signed by 25 local organizations & firms, and nearly 600 local residents)
- 2023/24 – Various communications have reinforced C3's position of strong support for the proposed plan, and urged faster ZEB adoption if pilots prove successful

Advocacy Community Input

Cville100 along with other community members have expressed ***support for the proposed transition***, while sharing some of the following concerns:

- Dissatisfaction with the near-term increase in diesel fleet and the cautious approach to ZEB adoption
  - Cited examples of other public transit agencies already transitioning from diesel
  - Favor more rapid adoption of ZEBs
- Skepticism regarding projected ridership improvements related to fleet expansion
- Frustration with conservative assumptions about battery technology and cost
- Concern about BEB performance in cold temperatures
- Doubts about the viability and climate benefits of hydrogen buses (FCEBs), preferring full transition to BEB fleet
- Alignment with federal and state climate goals & commitments
- Missing out on funding opportunities

Potential Hydrogen Sourcing



Office of Sustainability recommends sourcing of **green** or **yellow** hydrogen

Zero Emission Bus (ZEB) Technologies

- Each zero-emission technology currently has unique strengths and limitations

	BEBs	FCEBs
Reliability		+
Range		+
Operating Costs	+	
Initial Installation Costs	+	
Scalability		+

Office of Sustainability Recommendation

Office of Sustainability recommends that Council adopt the recommendations in the Alternative-Fuel Feasibility Study.

- Proposed fleet expansion will allow CAT to provide improved transit frequency and reliability, improving transit equity within the community
- Pilot approach will allow CAT maintenance staff to gain familiarity with two ZEB technologies prior to widespread fleet adoption
- Two proposed ZEB technologies each provide unique benefits and can provide redundancy in the event of problems with either type of propulsion system
- Leadership by example; plan achieves a zero-emission public transportation fleet by 2040
- Supportive of expediting the transition of ZEBs

***Note*:** Several transit agencies with BEB experience are incorporating FCEBs to address challenges

Note: The study's proposed transition guide presents additional ZEBs starting in 2031 - but it remains open whether those are BEBs or FCEBs.

Neighborhood Development Service

Update/Comments/Recommendations

CAT's Expansion Plans and Alternative Fuel Transition

CAT over the past decade

- Pre-COVID Pandemic

- 13 Routes (including the Trolley)
- Service generally 6 am to Midnight
- Sunday service on 4 routes
- Most routes on 30-60 min frequencies, highest frequencies on Trolley (15 min) and Route 7 (20 min)

- Lifeline Service

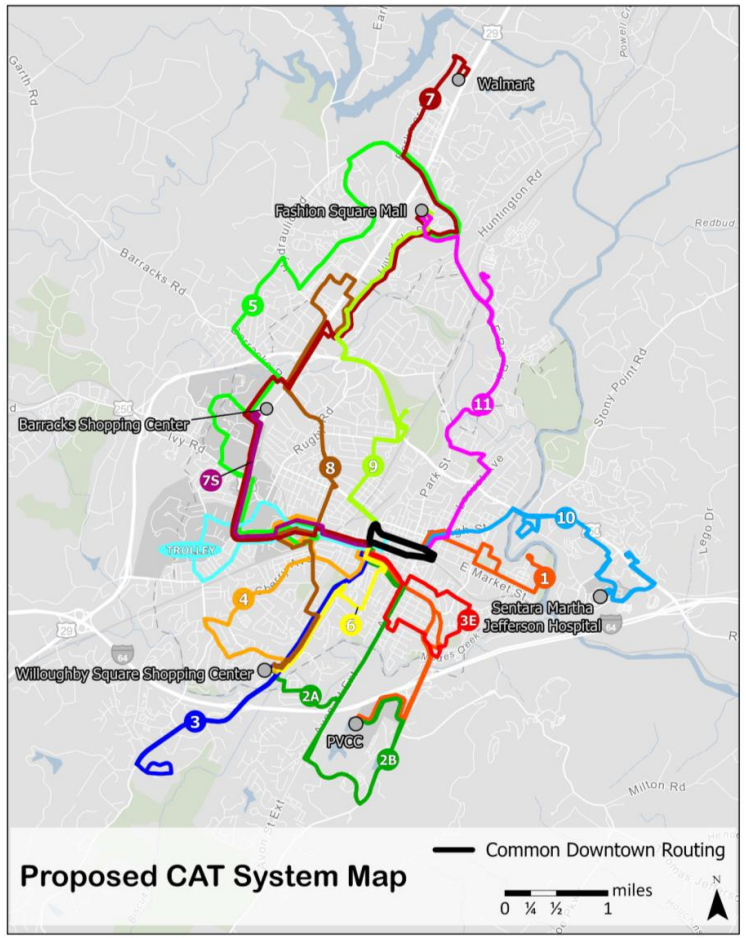
- Reduced routes, depending on availability of drivers, vehicles, parts
- Reduced nightly service hours
- No Sunday service
- Increased waits between buses on most routes

Didn’t we develop a plan to fix service?

- Yes! In 2021, City Council adopted the System Optimization Plan (SOP)
- SOP was aimed at providing a path forward for CAT to restructure routes more effectively and expand service, coming out of Lifeline service. It included:
  - Restored service coverage to pre-COVID levels
  - Created new areas of service in both the City and County
  - Expanded Saturday services and returned and expanded Sunday services
  - Required fewer transfers to reach major locations like CHS, UVA Hospital, Walmart, PVCC, and 5th St Station
  - Additional recovery time on routes to improve on-time performance
- The SOP has not been implemented, due to driver, vehicle, and parts shortages

Proposed Improvements from the SOP

- Improved service between UVA campus/Hospital and US 29 corridor (Routes 5 and 7)
- New crosstown service from south Charlottesville to US 29 corridor (Route 8)
- Proposed routes operating at 30-minute or better all-day weekday service (Routes 2, 3, 5, 7, 10, Trolley)
- Additional weekend service coverage (Routes 1, 3, 10)
- New coverage in county along Mill Creek Drive and to Monticello High School (Route 2B)
- New coverage to Piedmont Virginia Community College (Route 2B)
- New coverage in city with Route 5 extension to UVA Hospital and with Route 6 service on 1st Street South



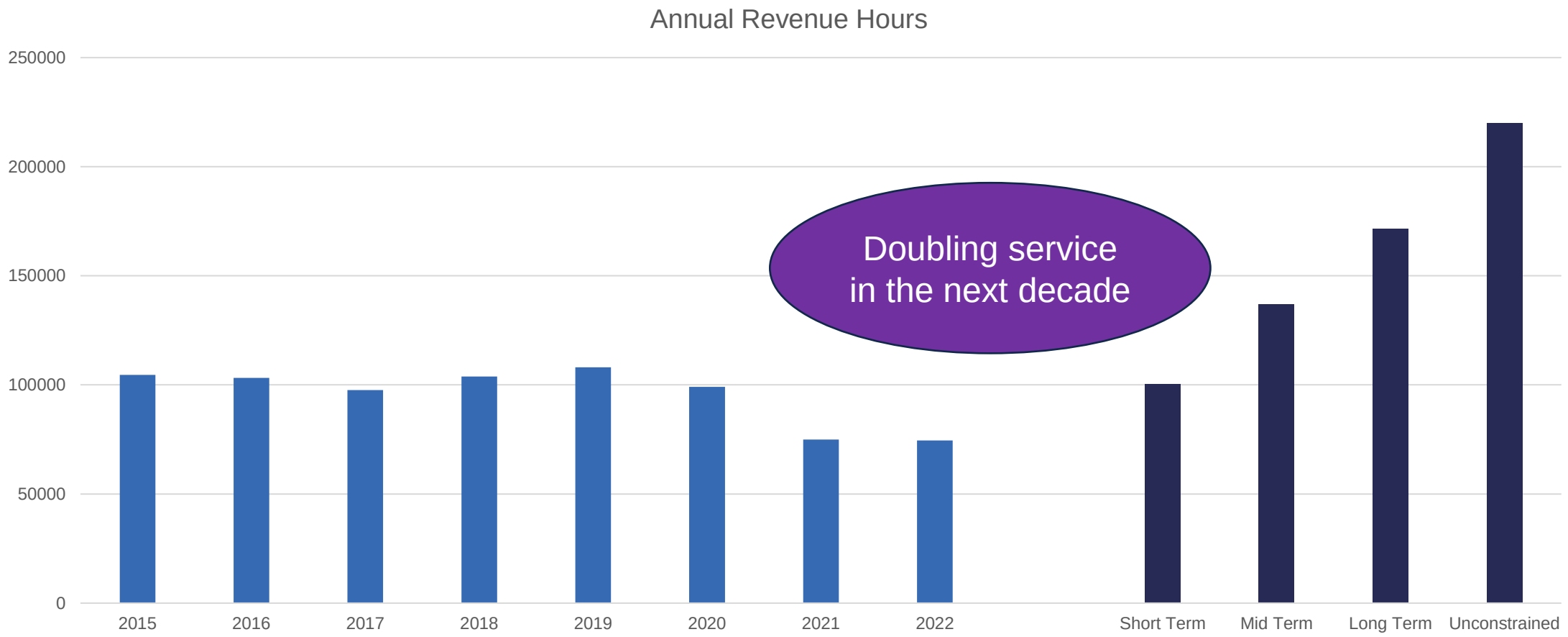
Not that plan- wasn’t there another one?

- Yes! In 2022, the Thomas Jefferson Planning District Commissionand Regional Transit Partnership developed a regional plan for transit services in the area served by CAT and Jaunt, called the Regional Transit Vision Plan
- This plan produced two long-range visions for transit in the region: an unconstrained plan that included everything we could wish for and a constrained plan that prioritized expansions of service within a fixed budget
- Some recommendations radically restructured existing routes and would warrant further discussion between the City and County before implementation (e.g. extending the Trolley to Pantops)

CAT's Current Planning Work

- CAT is currently working on its Transit Strategic Plan
- The Transit Strategic Plan (TSP) is a state-required document of planned service improvements over the next decade, necessary for securing federal and state operating dollars
- CAT's TSP is laying out a path away from existing Extended Lifeline service and toward the expanded services in the regional vision
- More details on CAT's TSP at 4/16 Work Session

How much service is CAT adding?



Historic
Revenue Hours

Draft CAT TSP Service
Recommendations

How does CAT expect to increase ridership in the next decade?

- Doubling the amount of service provided
- Increasing frequencies on all routes and making the Trolley, Route 5, and Route 7 high-frequency routes
- Expanding night service hours and Sunday service on all routes
- New bus shelters
- Coordination with the City, the County, and VDOT on sidewalks and safe access
- MicroCAT demonstration project and exploring expansion in the City and County
- Increased funding resources through the Regional Transit Partnership for increased operating and capital expenses
- Increased staff hiring
- Reliable buses

Alternative Fueled Buses Analysis

Analysis Assumptions

- Analysis was based on CAT's 2022 existing conditions
  - 2022 Fleet and Routes
  - CAT's system optimization plan's modifications were not included
- Assumptions based on 2022 market trends and technology capabilities

Technology Considerations

Resources

- Fuel Sourcing
- Vehicle Costs
- Training
- Funding

Operations

- Ease and Reliability
- Infrastructure Requirements
- Risks
- Flexibility and Scalability
- Administration
- Maintenance

Sustainability

- Environmental Impact (Local)
- Environmental Impact (Global)
- Resiliency
- Alignment with Local/Regional Policy

Technology Evaluation

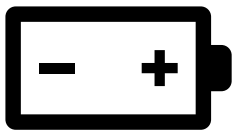
Battery Electric

+

- Zero Tailpipe Emissions
- Mature ZEB Technology
- Definitive Source of Fuel

−

- Large Fleet
- High Cost
- Range Concerns



Hydrogen Fuel Cell

+

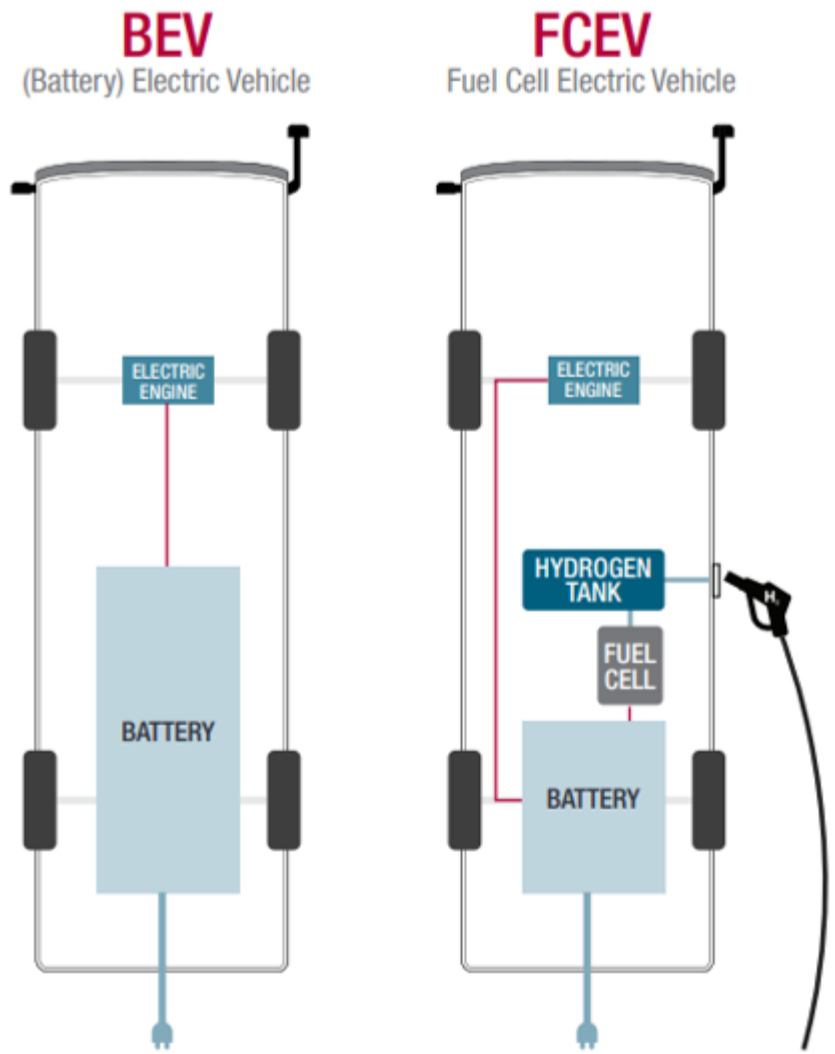
- Zero Tailpipe Emissions
- Resilient Operations

−

- High Cost to Deploy
- Lack of Fuel Supplier

Vehicle Propulsion Comparison

- Both technologies utilize batteries to power electric motors
- Fuel cell buses use hydrogen to charge a battery
- Battery electric buses use electricity from the grid to charge a battery



	Battery-Electric Bus (BEB)	Fuel Cell Electric Bus (FCEB)
Propulsion	Convert electricity from onboard batteries into propulsion through electric motor.	Convert electricity from both a hydrogen fuel cell and onboard batteries into propulsion through electric motor.
Emissions	Produce zero tailpipe emissions.	Produce zero tailpipe emissions.
Refueling/ Recharging	May be charged overnight or fast-charged on route using plug-in, overhead pantograph, or in-ground inductive charging.	May be refueled with hydrogen dispensed from pump.
Training	Requires new training for operators, mechanics, and route planners.	Requires new training for operators and mechanics.
Infrastructure	Requires additional facility space, charging equipment, and infrastructure.	Would require hydrogen fuel delivery and storage or on-site production. Requires facility space for hydrogen storage, compression, and dispensing equipment.

Battery Electric Buses

- Range of 150-350 miles
  - Range significantly affected by external factors - weather, elevation gain, battery degradation, driver aggression, and bus occupancy can all decrease bus range
- Higher purchase price than diesel buses
  - Average purchase price of a BEB is $1,000,000*
  - Costs are likely to increase significantly in 2024 and beyond
- Options include depot charging, on-route charging, or a combination
  - Depot charging typically takes 5-8 hours for a full charge
    - One charger can service 1 to 4 vehicles
  - On-route charging can extend vehicle range indefinitely

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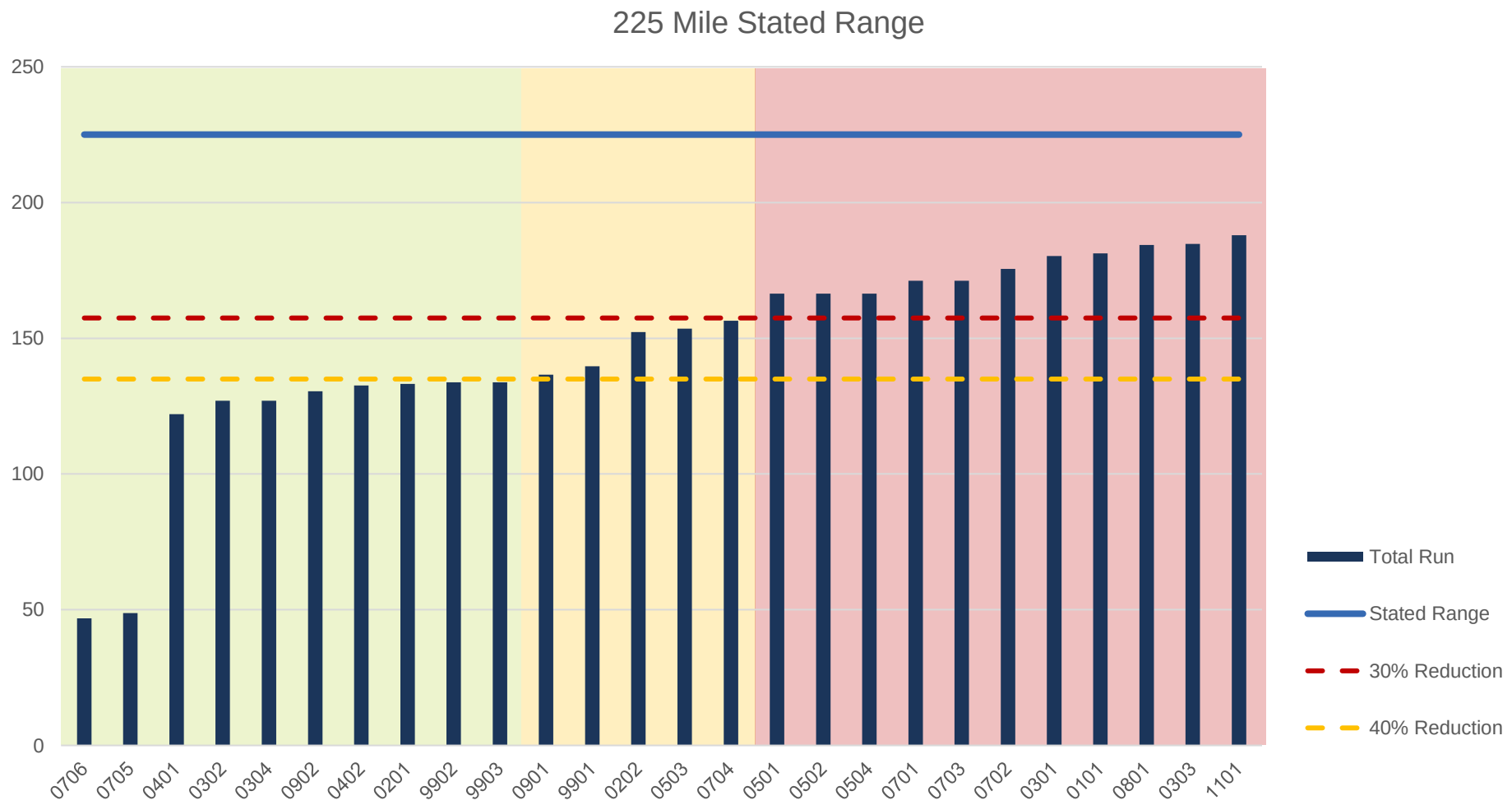
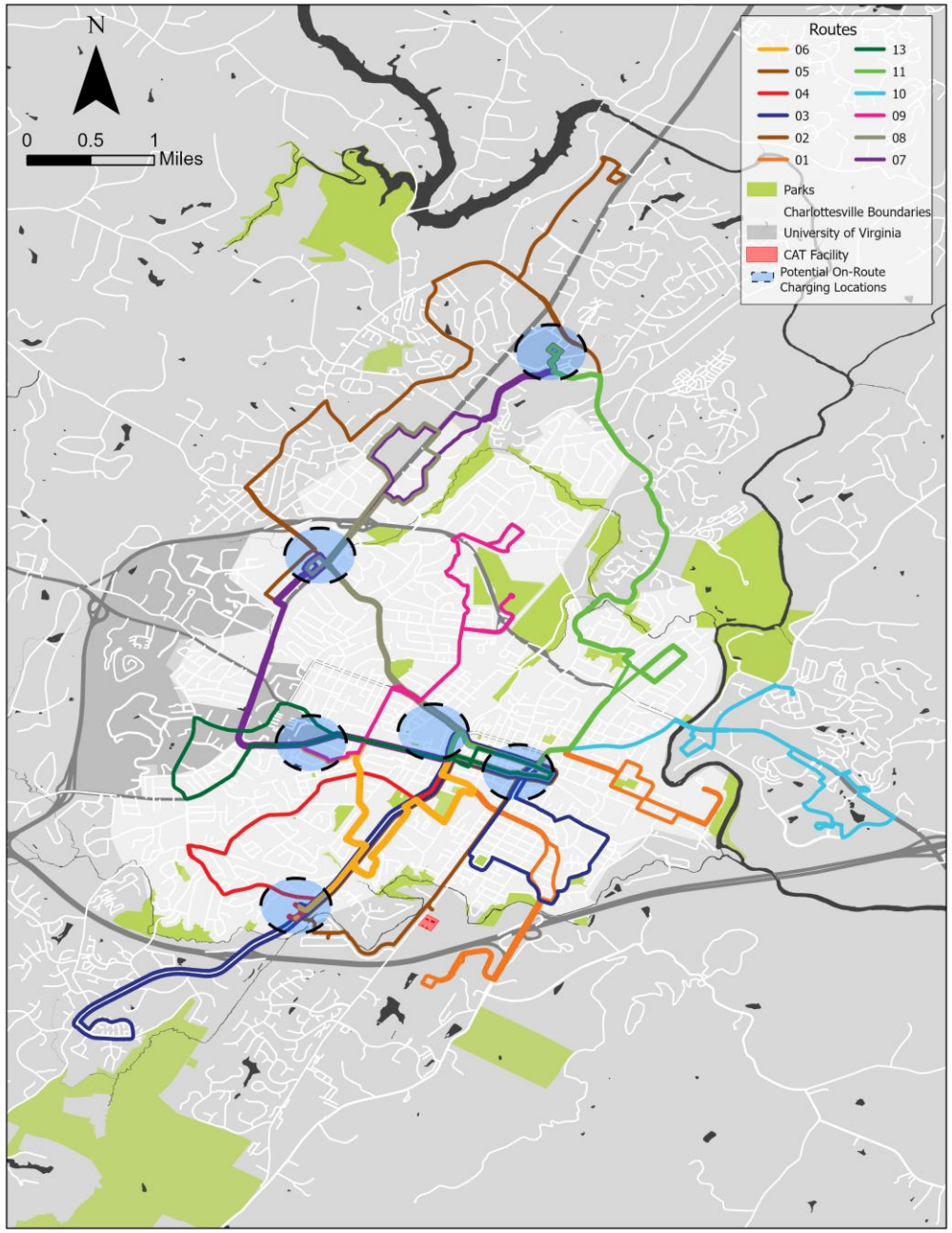
Battery Electric Buses Analysis

- Most BEBs on the market would not be able to consistently complete CAT's existing blocks
- A transition with BEBs would likely require a mix of bus technologies or alternative fleet arrangement:
  - Procure additional BEBs (greater than a 1:1 ratio)
  - Restructure blocks/routes or vehicle assignments
  - Use of on-route charging
  - Purchase higher-end BEBs with larger batteries and/or auxiliary heaters

BEB Range Analysis





Potential On-Route Charging Locations

- Downtown Station
- Willoughby Square Shopping Center
- Cabell Hall/UVA Hospital
- Fashion Square Shopping Center
- Barracks Road Shopping Center
- Charlottesville Public Works Facility

Hydrogen – Fuel Cell Buses

- Range of 260-350 miles
  - Less susceptible to range decreases than BEBs
  - Some models may experience weather related degradation
- Refueling takes around 10 minutes
- CAT would likely be able to perform a 1:1 transition
- Higher purchase price compared to BEBs, and diesel buses
  - Average cost for a FCEB is $1,150,000
- No commercial hydrogen provider near Charlottesville
  - On-site hydrogen generation and constructing a hydrogen fueling station is a significant capital expenditure

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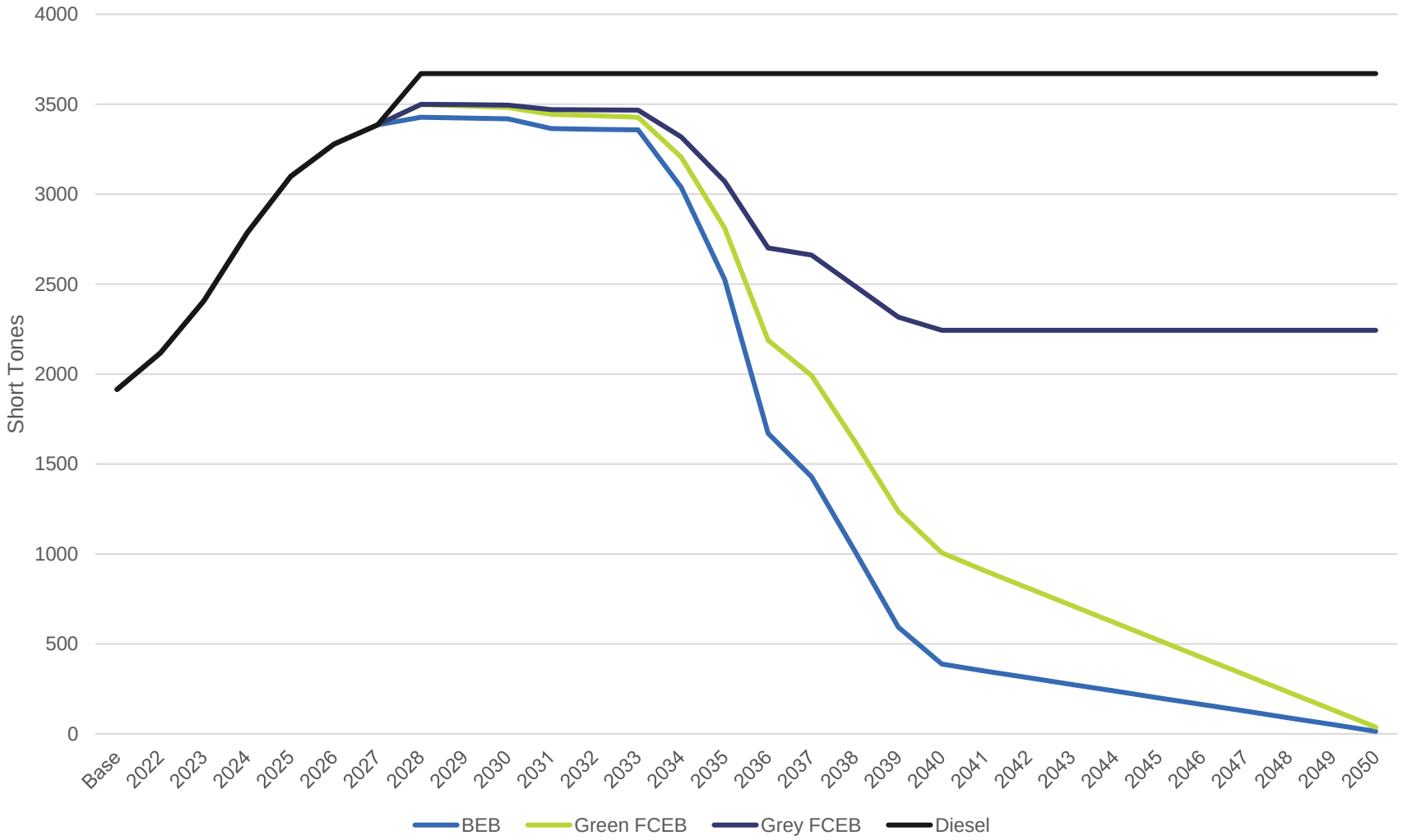
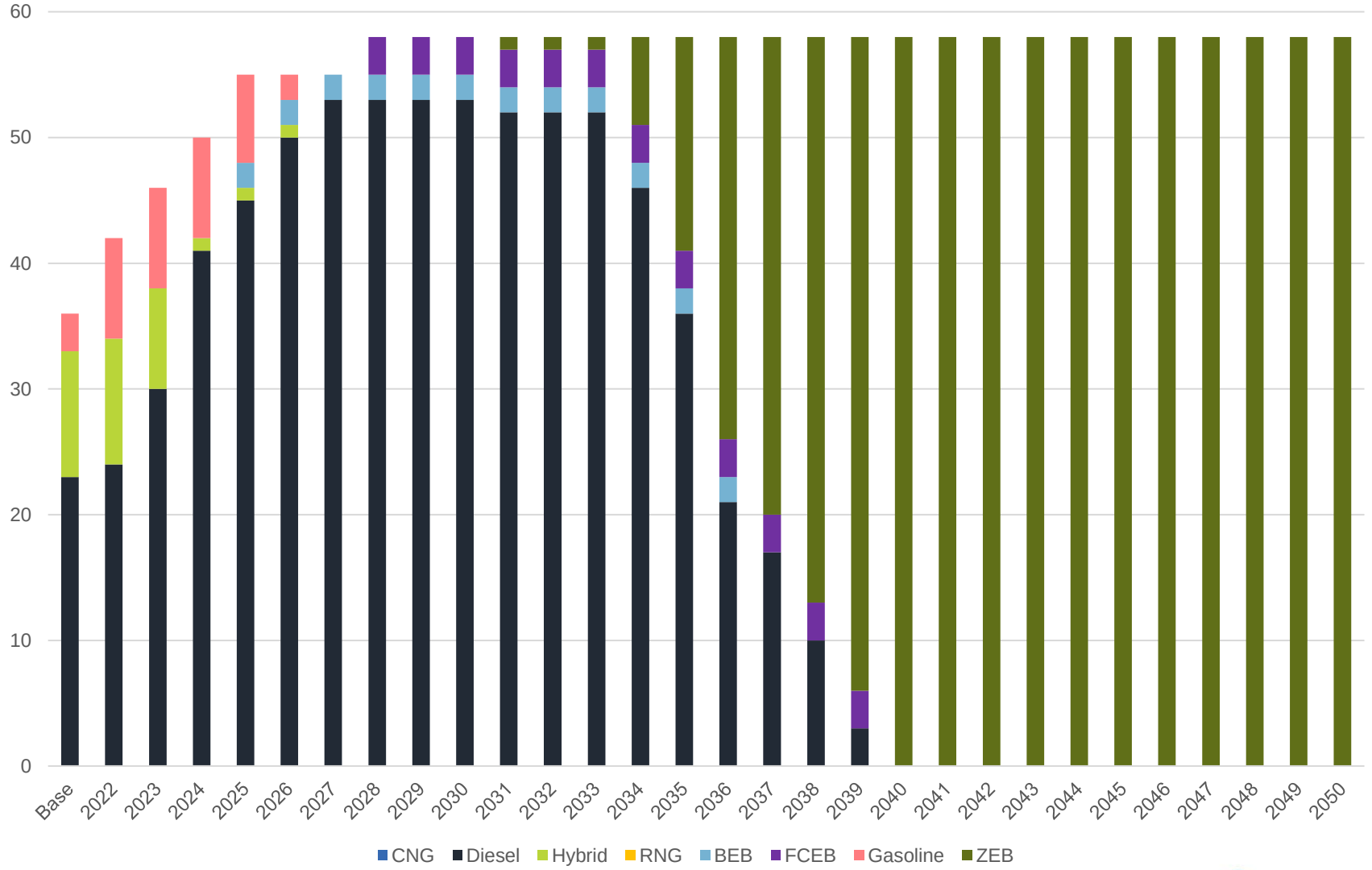
GHG Emissions



- The initial rise in emissions is due to fleet expansion
  - Peak fleet (58) is achieved in 2028
- 2050 reduction in GHG emissions compared to 2021's diesel fleet
  - BEB: 99.4%
  - Green FCEB: 99.0%
  - Grey FCEB: 38.9%

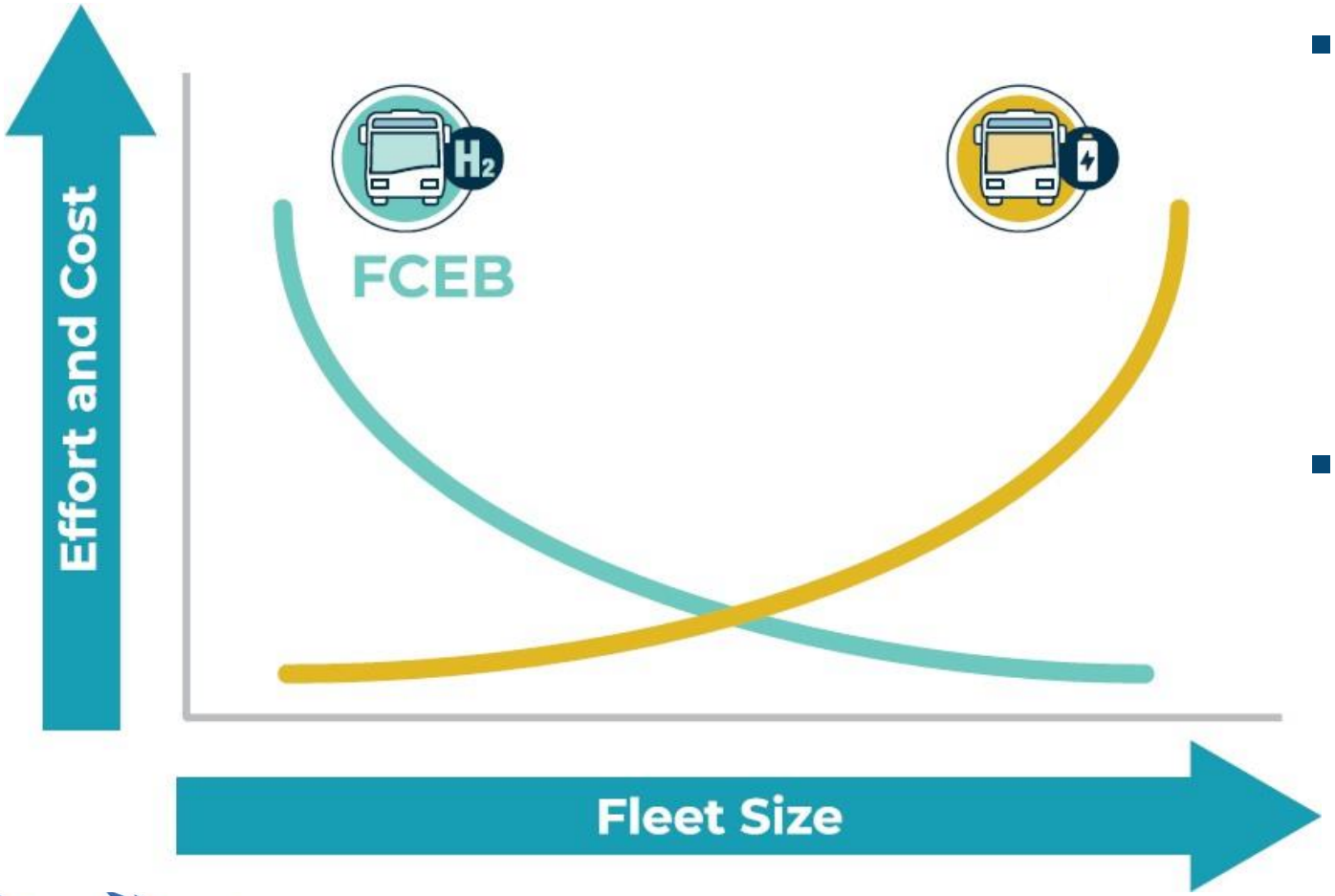
ZEB Transition Guide

- 2025 – 2 BEBs added to fleet as expansion vehicles
  - 2028 – 3 FCEBs will be added to fleet as expansion vehicles
- 2040 – First year for a potential 100% ZEB fleet
  - Assumes 12-year lifespan for buses



Scenario	Number of Vehicles	Emissions Reductions		Vehicle Costs (Local Match)	Facility Costs (Local Match)	Operational Costs [Fuel + Maintenance] (Local Match)
		Long-Term	Near-Term			
Diesel (Baseline)	58 (40 Current)	-		$29M ($1.2M)	N/A	$2.2M ($550K)
Battery Electric	94	99.4%	6.8%	$83.5M ($3.3M)	$6.3M ($300K)	$1.1M ($275K)
Battery Electric w/ Fast Charging	63	99.6%	6.8%	$56M ($2.2M)	$6.3M ($300K)	$1.2M ($300K)
Battery Electric (Low-Estimate)	58-63	99.6%	6.8%	$49M - $56M ($2.0M - $2.2M)	$3.7M - $6.3M ($100K - $300K)	$1.1M - $1.2M ($275K - $300K)
Hydrogen	58	99.0%	5.1%	$64M ($2.6M)	$5.7M ($200K)	$1.9M ($475K)

Hydrogen BEB Capital Costs



- **Fuel Cell becomes more cost effective with more vehicles**
  - Higher initial capital costs
  - Infrastructure cost per bus decrease as more buses are added
- **Battery Electric costs scale with the deployment size**
  - Chargers need to be procured and installed for every new bus added
  - Electric utility infrastructure may need to be expanded

Funding

- Technology selection affects the Transit Strategic Plan (TSP)
- Technology inclusion within TSP impacts ability to pursue state funding for vehicles and infrastructure
- FTA Low or No Emission competitive grant applications due April 25th

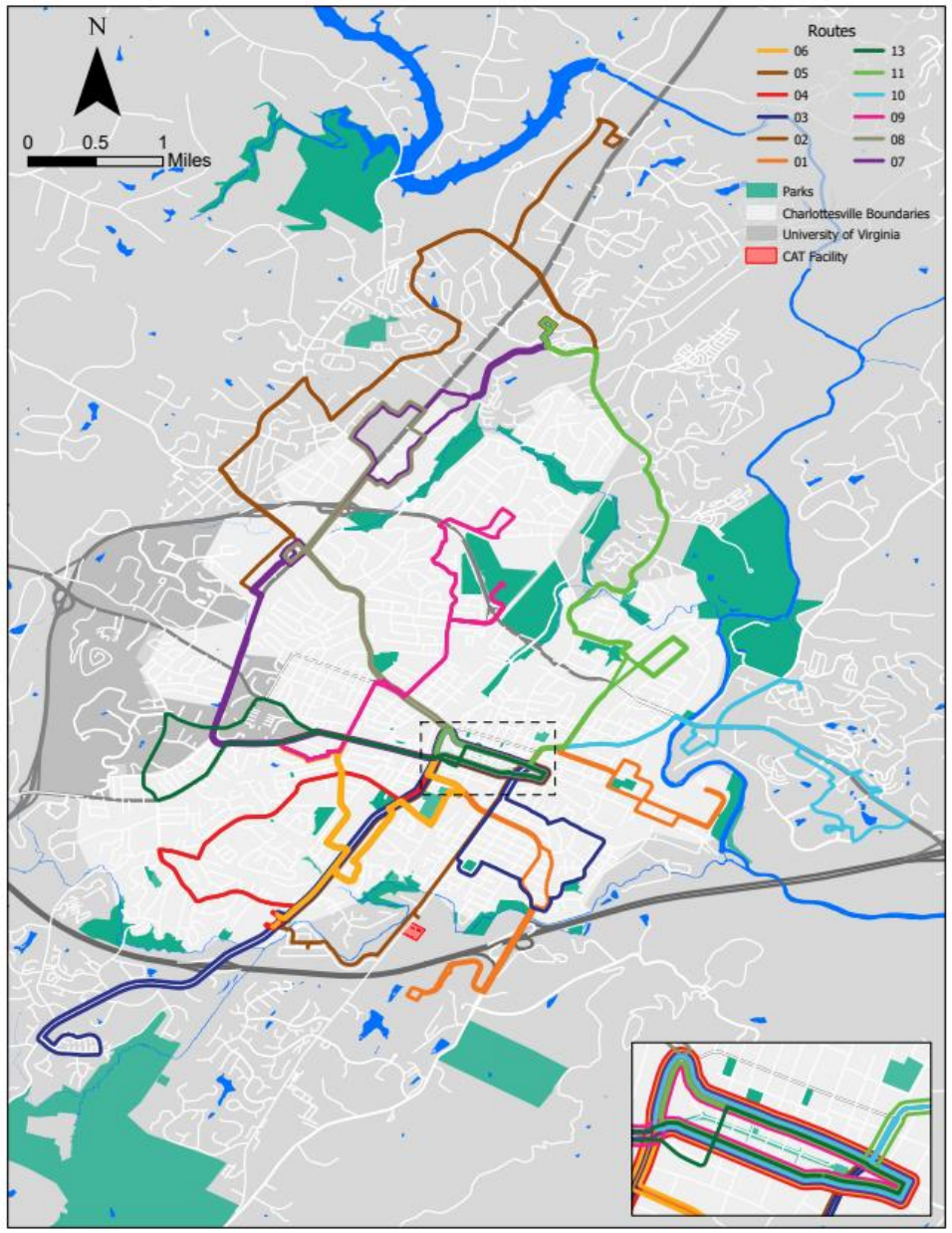
Performance-Based Funding

- DRPT allocates operating funds based on:
  - Agency size
  - Performance

- Performance Metrics
  - Passengers per Vehicle Revenue Hour
  - Passengers per Vehicle Revenue Mile
  - Operating Cost per Vehicle Revenue Hour
  - Operating Cost per Vehicle Revenue Mile
  - Operating Cost per Passenger

- Ridership and cost efficiency are rewarded

CAT Survey Results



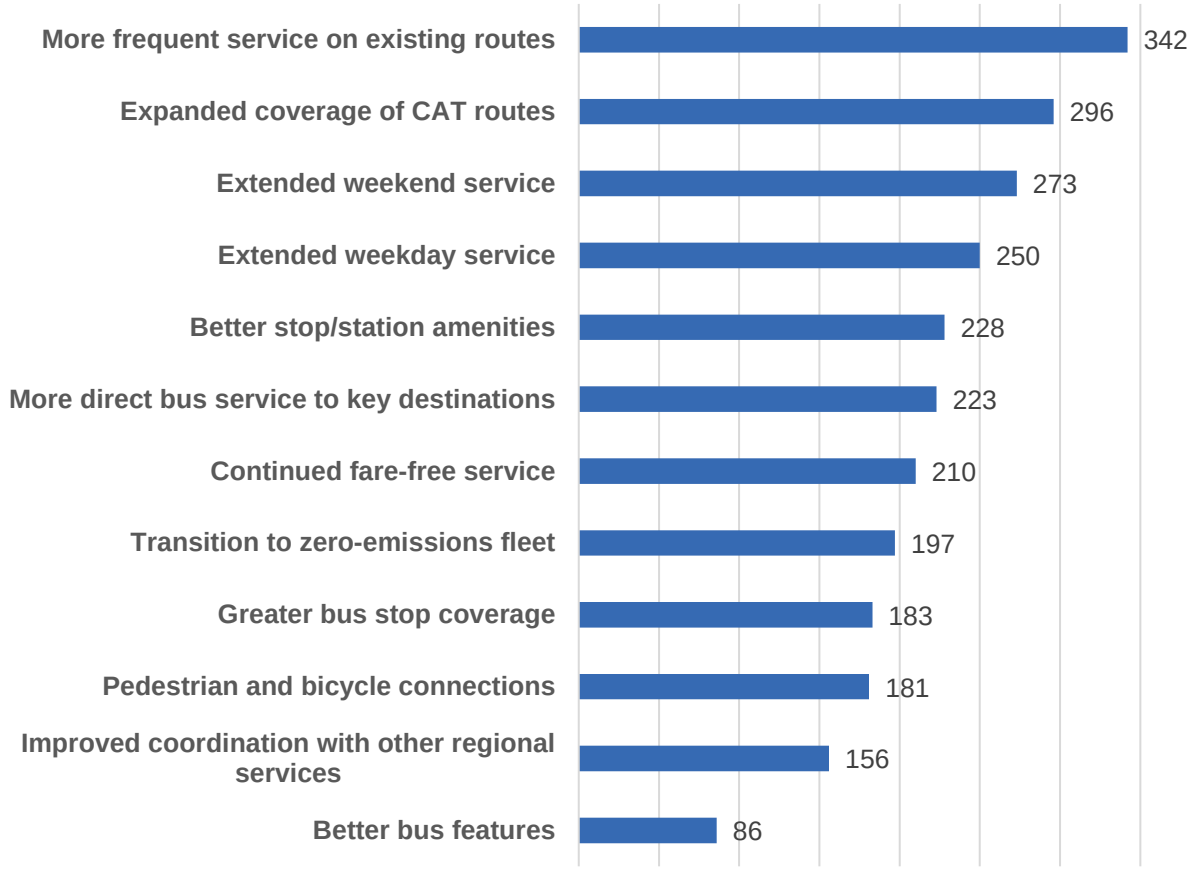
CAT's Current System

- 12 Routes
  - 20 operating blocks*
- Serves Charlottesville and urban areas in Albemarle County
- Operating hours typically 6:00am – 10:30pm

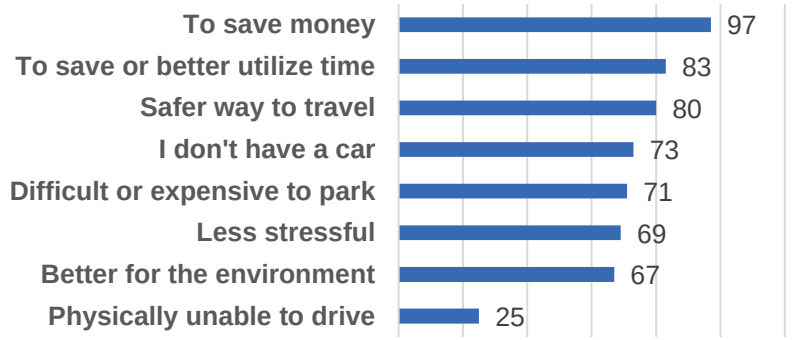
* Blocks are equivalent to a vehicle's work cycle

Transit Strategic Plan
- Public Survey Findings

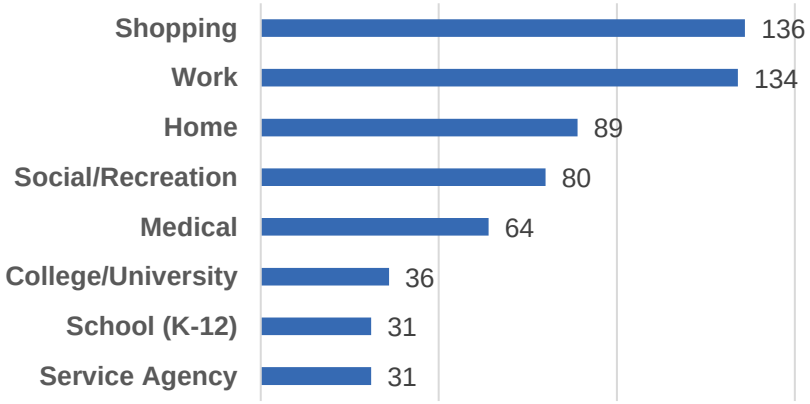
Priorities of Survey Respondents



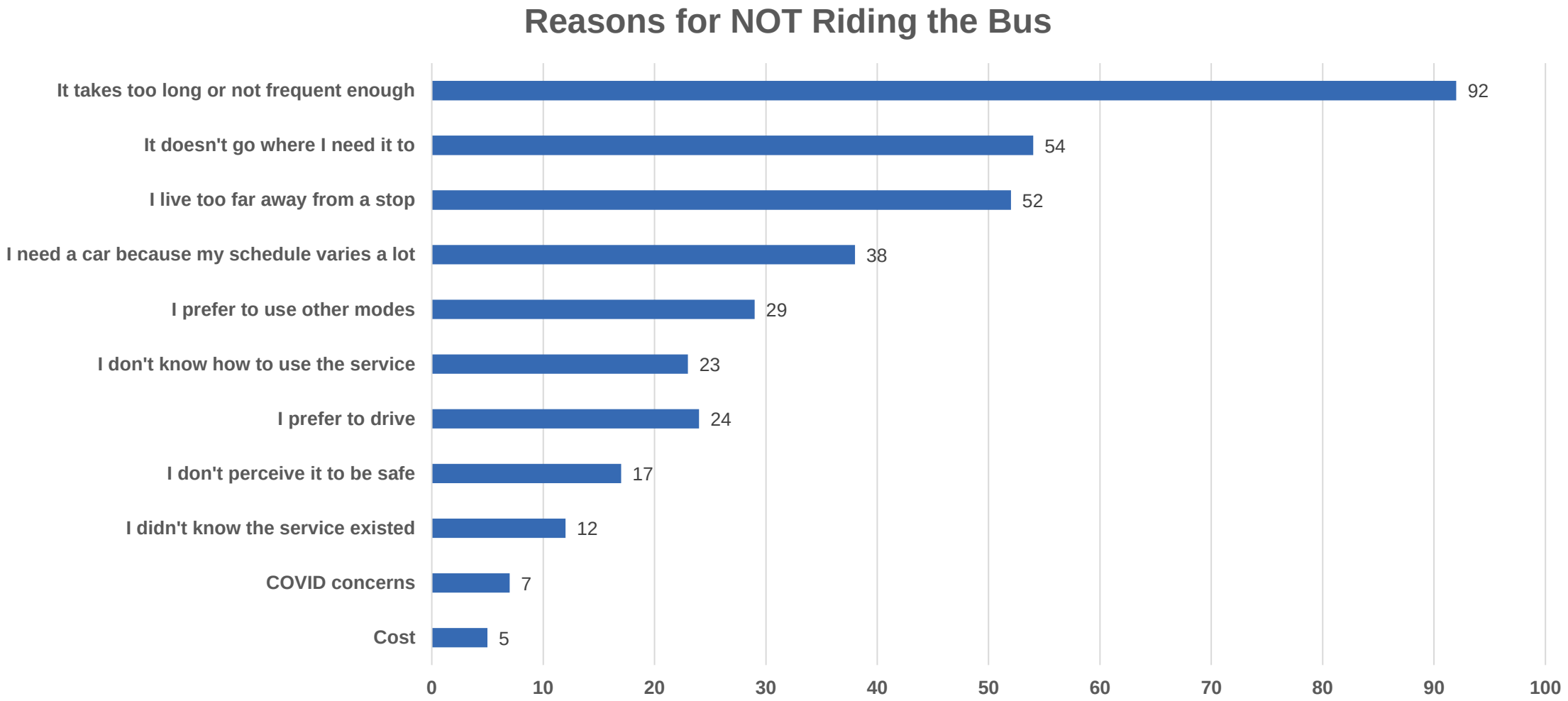
Reasons for Riding the Bus



Trip Purpose/Destination



Transit Strategic Plan
- Public Survey Findings



Transit Network Accessibility

- **Population accessibility improvements:**
  - Weekdays = +2%
  - Saturdays = +5%
  - Sundays = +10%

- **30-minute or better weekday service**
  - Overall population accessibility = +20%
  - Minority population accessibility = +16%
  - Low-income population accessibility = +15%

Next Steps

- Finalize the alternative fuel feasibility study
- Begin the conceptual site design of the CAT facility expansion and additional site improvements
- Complete zero-emissions transition plan requirements for FTA

Discussion

New Scenario

- Pilot Gillig and NF BEBs
  - Range/battery assumptions
  - Fast charging
  - Timeline/phasing of purchases
  - How many pilots?
  - Different charge management systems, will need to integrate data for analysis and day-to-day Ops/Maint. needs

Next Steps

Item	Units	Quantity	Unit Price	Amount	Notes
BEBs	EA	4	$ 1,100,000	$ 4,400,000	Industry average for 35' BEB taken from draft DRPT Low- or Zero-Emissions Transition Plan Template, Emissions Reduction Tool, and Financial Analysis Tool. Uses average prices from 2023 VA statewide contract. No add-ons/upgrades assumed.
Depot Charger	EA	1	$ 150,000	$ 150,000	Heliox: $125k ($75k for 1 cabinet, $15k per dispensor to charge up to 3 vehicles at a time) includes 2 year commissioning warranty or 60 days past delivery (which every comes first). $15k commissioning on site. Does not include install (included $15k install and incidentals)
Depot Charger Installation	EA	1	$ 15,000	$ 15,000	see note above
Depot Utility Work	LS	1	$ 100,000	$ 100,000	placeholder; difficult to estimate at this time
Fast Charger (Pantograph)	EA	2	$ 1,500,000	$ 3,000,000	estimate includes installation and utility work, but not ROW. 1depot/1 on-route. Based on published costs estimates from other properties.
On-route ROW acquisition	LS	1	$ 1,000,000	$ 1,000,000	placeholder - assume purchase of a parcel for on-route charging location
TOTAL				$ 8,665,000	Does not include backup generator, energy storage system, other development costs associated with an on-route charging location (e.g. paving, security, amenities, etc.)