Kimley»Horn

Expect More. Experience Better.

Charlottesville Area Transit Facility Design and Zero Emissions Vehicles

City Council Update

July 2023

Today’s Purpose

- Update Council at the current project milestone
- Provide an opportunity for Council to ask questions
- Solicit perspective from Council members

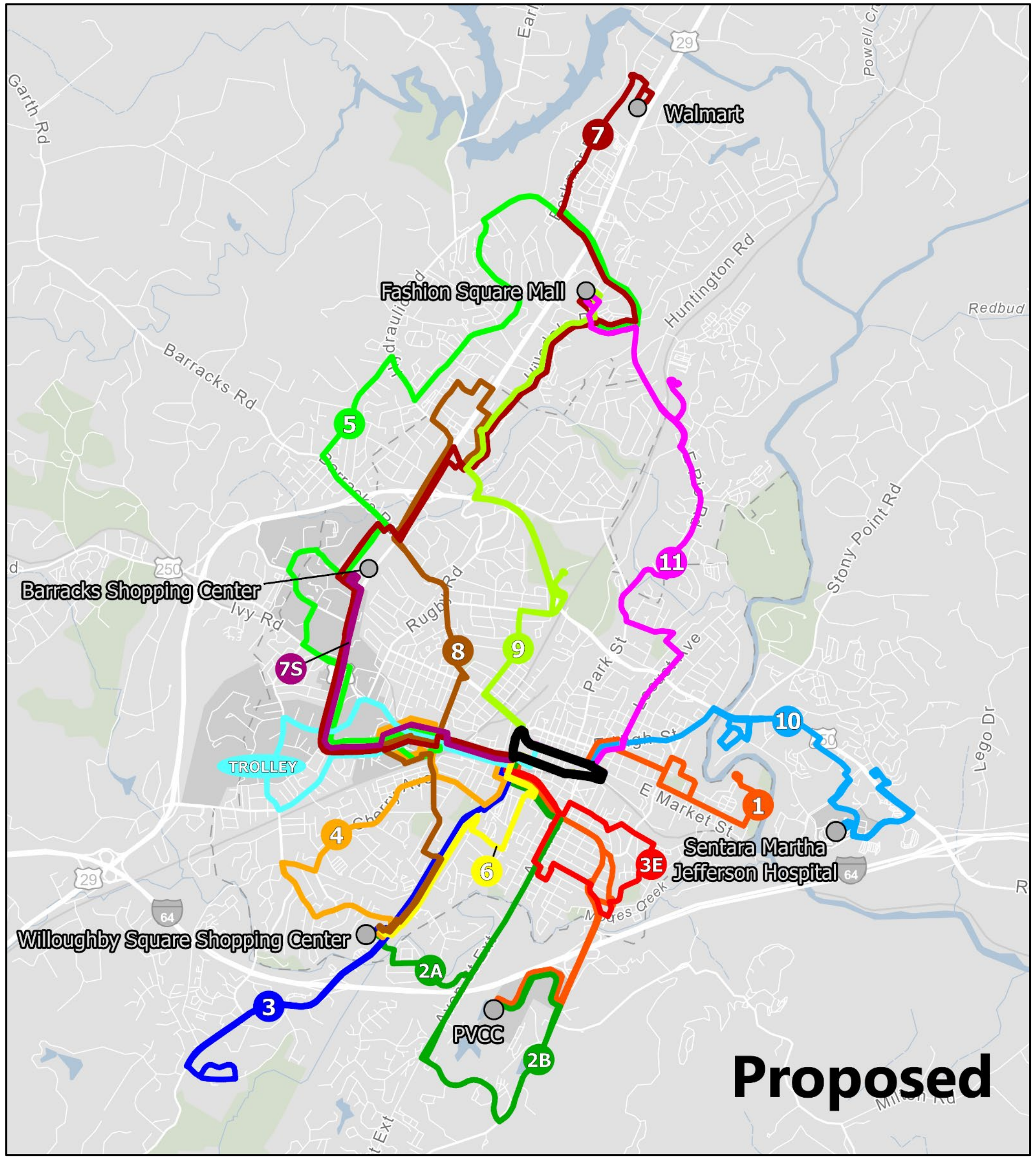
Schedule

- Feasibility Study and Environmental Assessment
  - May 2023 for Staff
  - July 2023 for City Council
- Space Program
  - Summer 2023
  - On-site visit: August 2023
- Site Master Plan
  - Fall 2023
- Zero Emissions Bus Transition Plan
  - Fall 2023

Background Information

Going Low- or Zero-Emission

- Charlottesville and Albemarle County implemented a climate action plan
  - Decrease GHG emissions 45% by 2030
  - Reach carbon neutrality by 2050
- There's substantial funding available for transit agencies in transitioning to ZEBs from Federal Sources
- Market and industry trends are moving towards low- and zero-emission vehicles



CAT's System Optimization

- 15 Routes
  - 26 operating blocks*
- Serves Charlottesville and urban areas in Albemarle County
- Operating hours typically 6:30am – 11:00pm

** Blocks are equivalent to a vehicle's work cycle*

Factors for Consideration

Resources

- Fuel Sourcing
- Vehicle Costs
- Training
- Funding

Operations

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

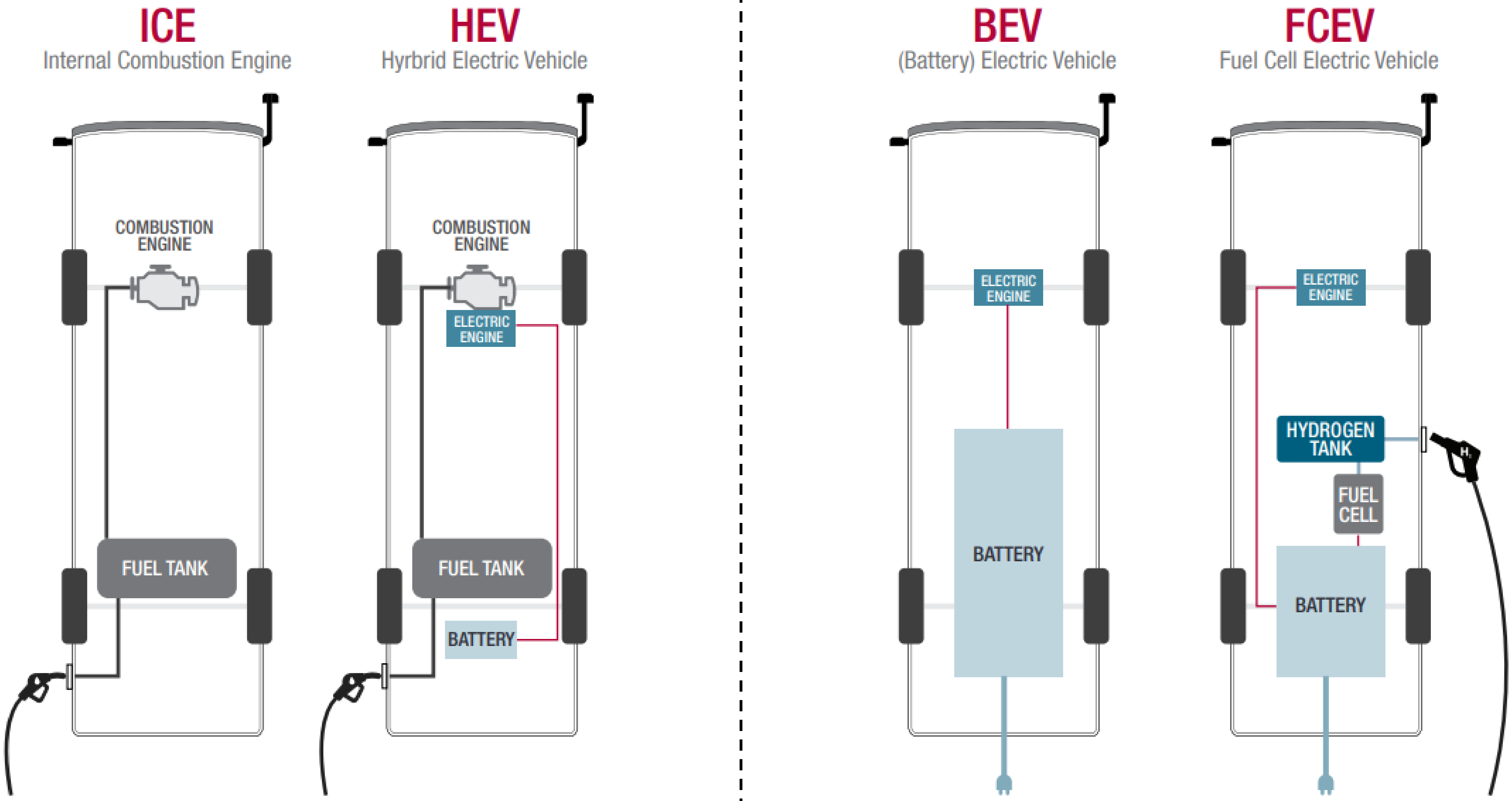
Sustainability

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

Technology Feasibility

Produces Emissions

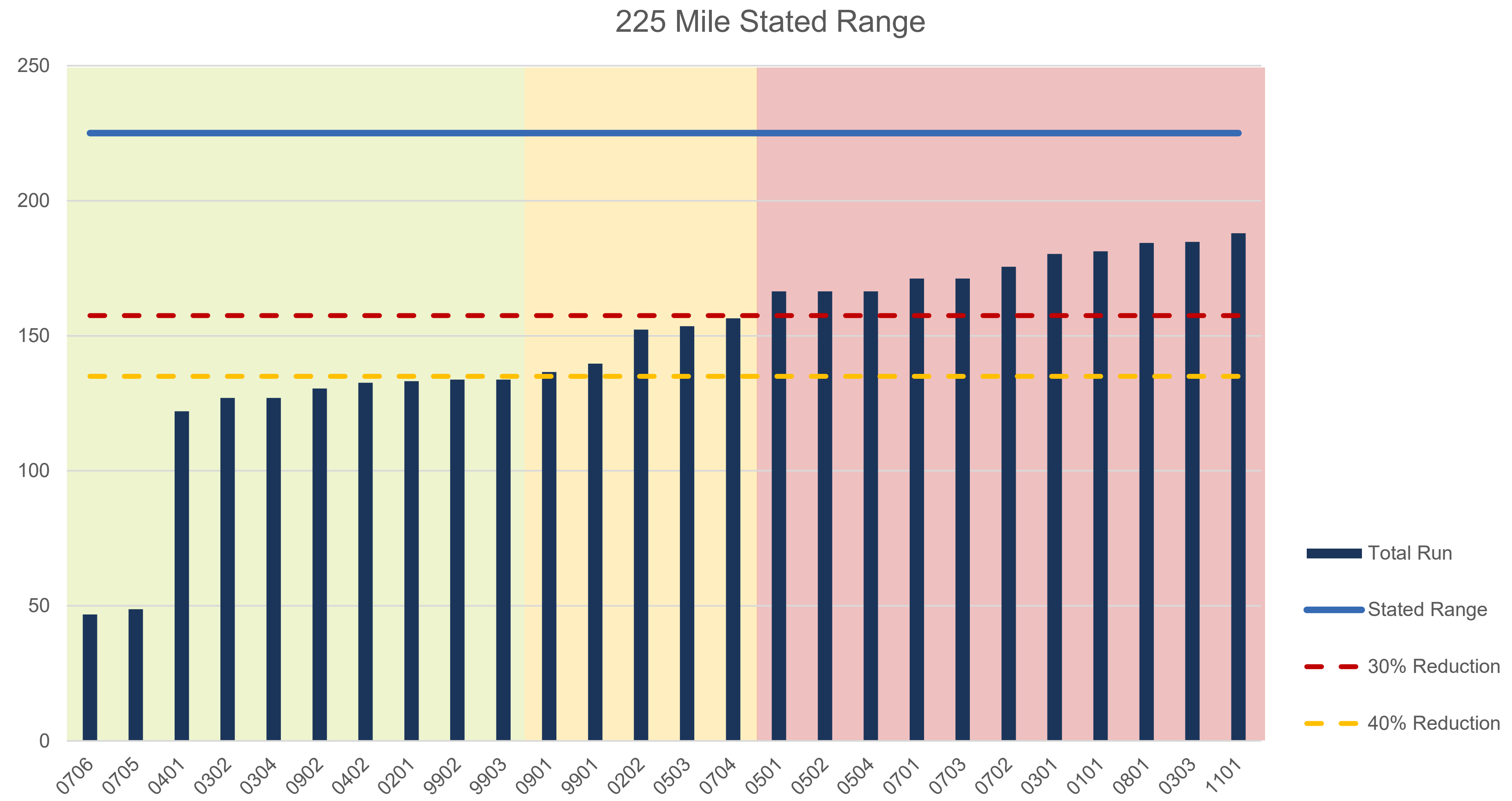
Zero Emissions



Scenarios

- Current: Diesel-only fleet (hybrid transitioning to clean diesel)
- Battery Electric:
  - 1.62:1 replacement ratio, assuming 40% reduction on range
  - Fast Charging, assuming 1 location with multiple bays at Downtown Transit Hub
  - 1:1 replacement ratio, assuming future technology advancements
- Hydrogen
  - Assumes construction of new cryogenic storage and fueling facility
- CNG/RNG
  - Assumes construction of new fueling facility

BEB Range Analysis



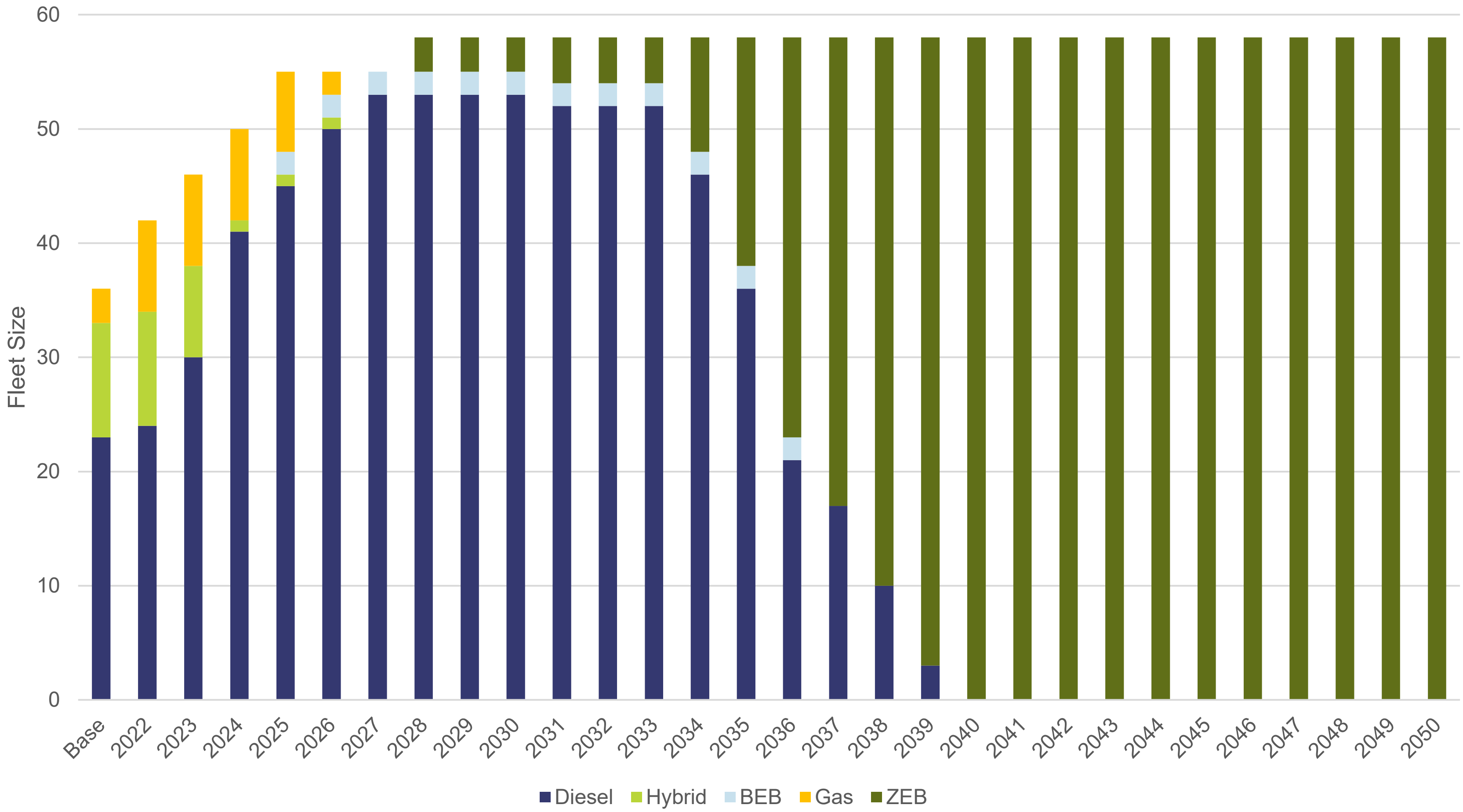
BEB Transition Potential

Routes	BEB Transition Potential	Description
7s	✔✔	Has the greatest potential of successful operations under a BEB transition
2A, 3E, 4, 6, 9	✔	Routes can be completed under strenuous conditions
2B, 3, 10, Trolley	≈	Not all operation blocks could be transitioned **OR** routes could not be completed under strenuous conditions
1, 5, 7, 8, 11	✘	Cannot be transitioned to BEBs with current technology and blocking

Transition Plan Scenarios

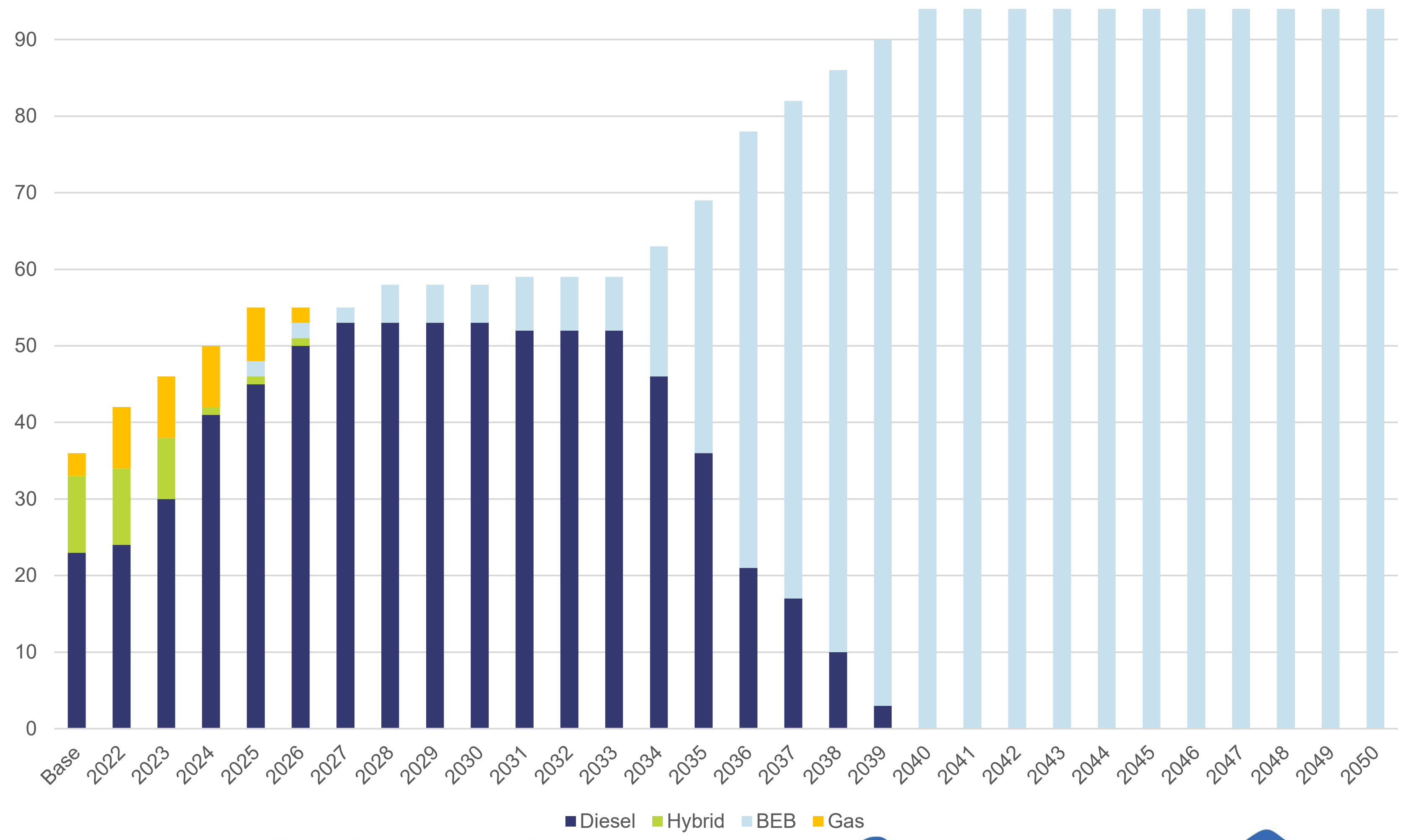
Transition Plan Scenarios: Hydrogen, CNG, BEB (*with* fast charging)

- "ZEB" generic term
- 2025 – Two BEBs added to the fleet as expansion vehicles
  - 2028 – Dependent on BEB performance, three planned diesel expansion buses could be swapped for ZEBs
- 2040 – First year for a potential 100% ZEB fleet
  - Assumes 12-year lifespan for buses



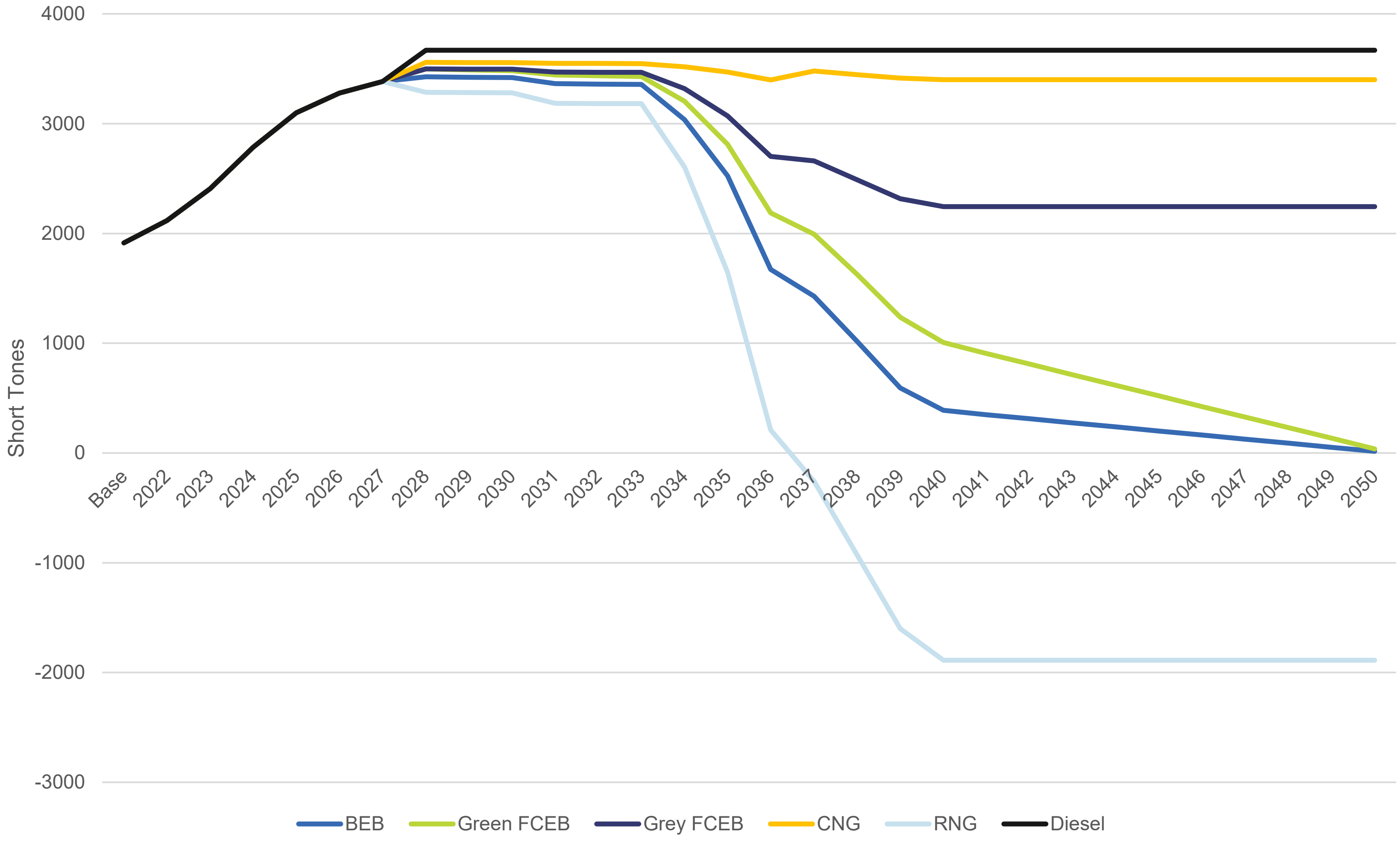
Transition Plan Scenarios (continued): BEB (*without* fast charging)

- Total fleet size of 94 vehicles
  - 1:1.62 Diesel to BEB replacement ratio
  - Replacement ratio based on current block completion analysis
- Total fleet size is dependent on future range improvements for BEBs



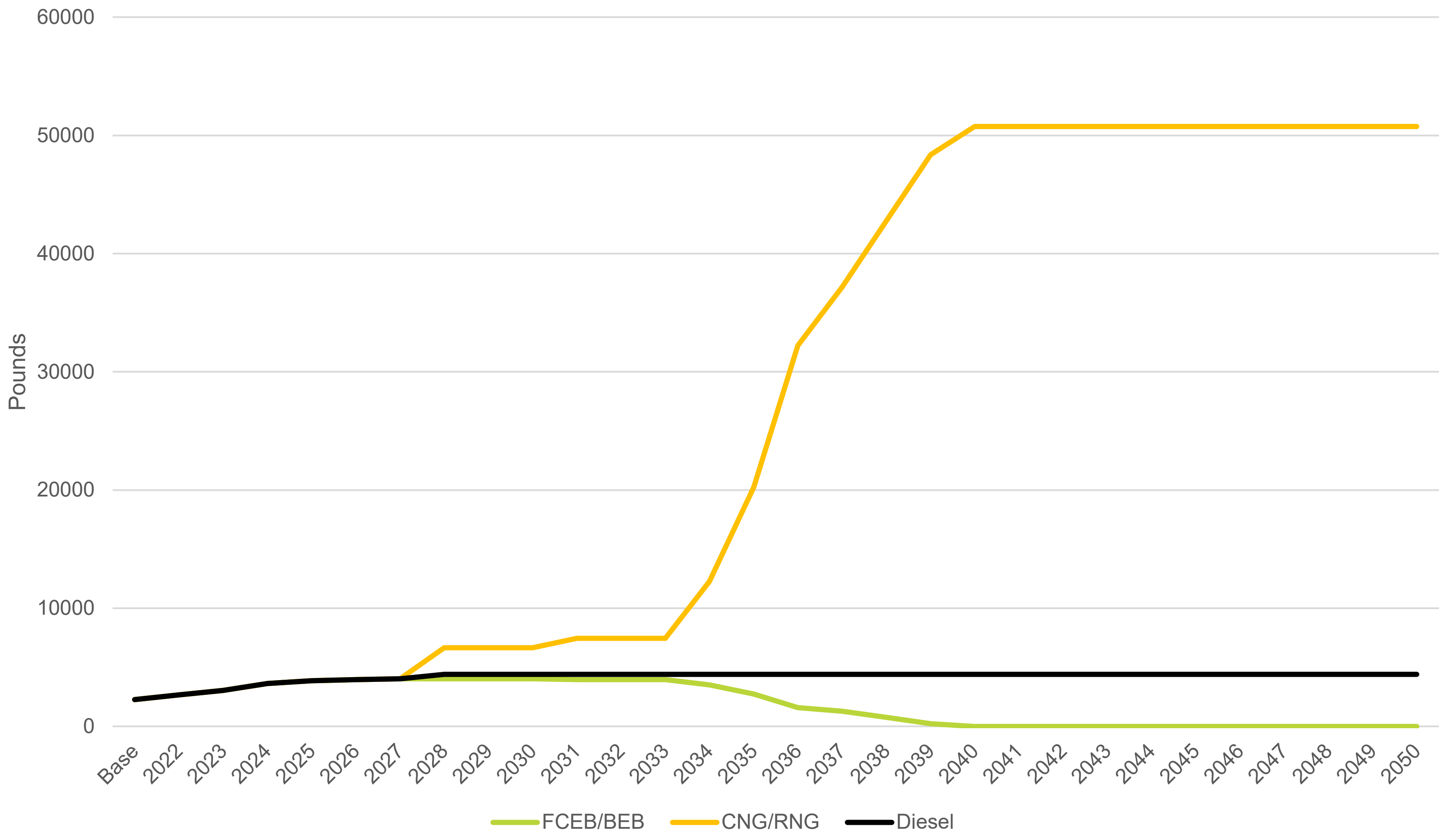
Climate and Health Assessment

GHG Emissions



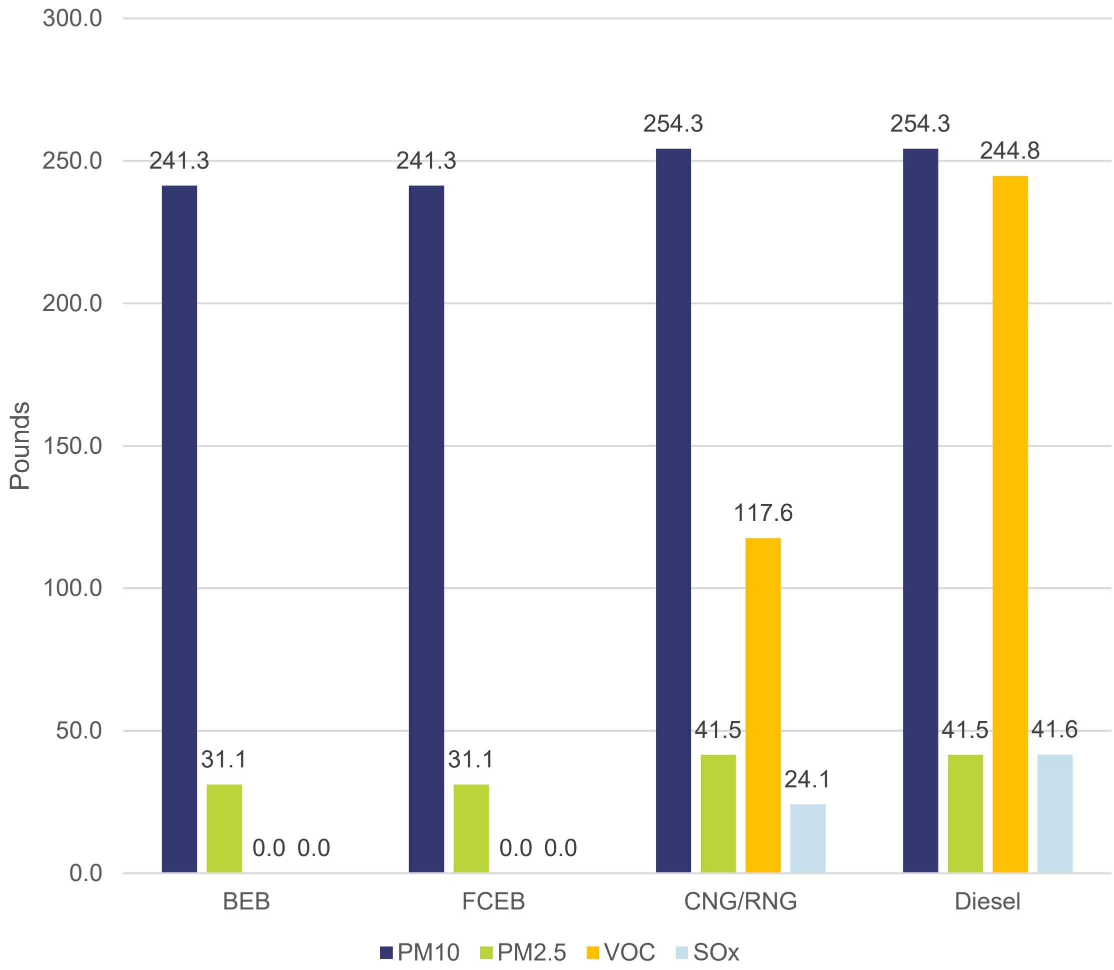
- The initial rise in emissions is due to fleet expansion
  - Peak fleet (58) is achieved in 2028
- 2050 reduction in GHG emissions compared to diesel fleet
  - RNG: 151.4%*
  - BEB: 99.4%
  - Green FCEB: 99.0%
  - Grey FCEB: 38.9%
  - CNG: 7.3%

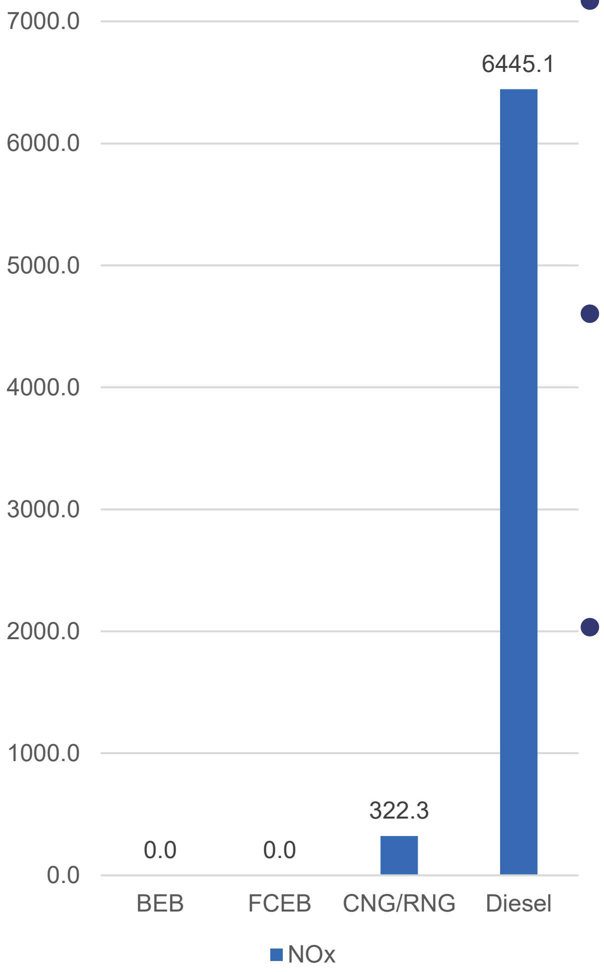
Carbon Monoxide Emissions



- BEB and FCEB transitions eliminate carbon monoxide emissions
- CNG and RNG transitions increase carbon monoxide emissions by 1050% from diesel fleet

Other Emissions (2050)





- Emissions based on complete transition and 2050 electrical grid
- FCEB and BEB transitions eliminate local NOx, VOC, and SOx emissions
- CNG and RNG transitions produce the same levels of local pollutants

Comparison of Scenarios

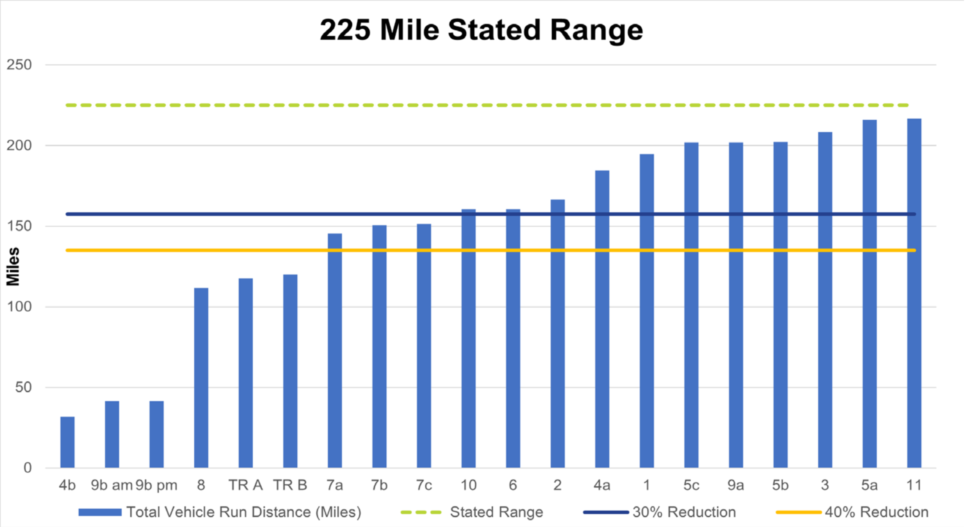
Scenario	Number of Vehicles	Emissions Reductions		Vehicle Costs	Facility Costs	Operational Costs (Fuel + Maintenance)
		Long-Term	Near-Term			
Current	58 (36 Current)	-		$29 M	N/A	$2.2 M
Battery Electric	94	99.4%	6.8%	$83.5 M	$6.3 M	$1.1 M
Battery Electric w/ Fast Charging	63	99.6%	6.8%	$56 M	$6.3 M	$1.2 M
Battery Electric (Low-Estimate)	58	99.6%	6.8%	$49 M	$3.7 M	$1.1 M
Hydrogen	58	99.0%	5.1%	$64 M	$5.7 M	$1.9 M
CNG (RNG)	58	7.3% (151.4%)	3.1% (10.6%)	$32 M	$2.3 M	$1.2 M

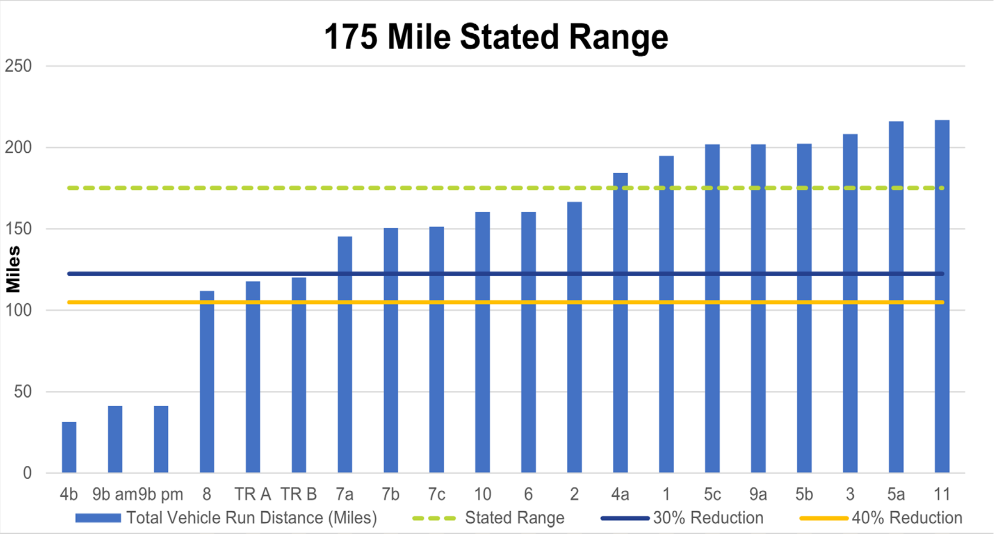
Next Steps

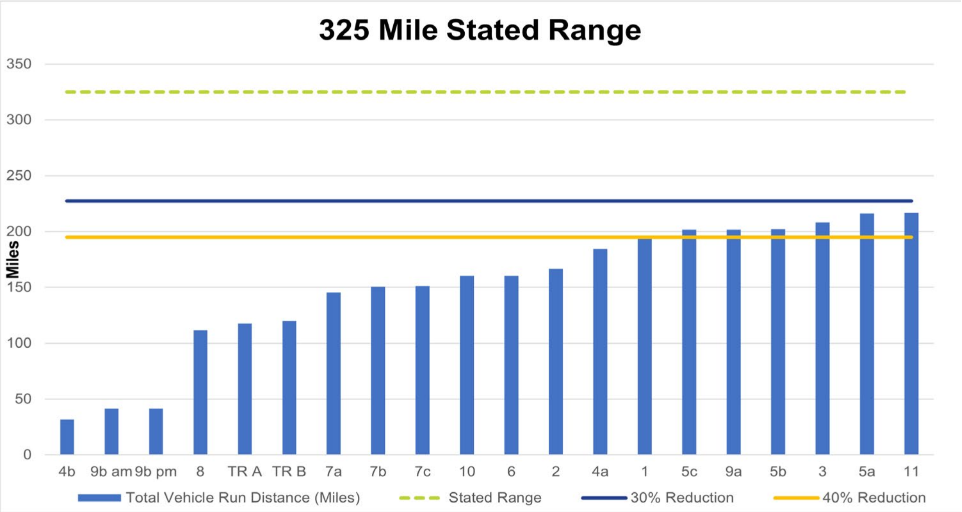
- The project will consolidate this discussion into a draft staff-recommended action
- We will document this in our feasibility study for your review and comment
- The project team will present the final revised action to City Council for approval
- The project team will proceed on to conceptual facility design

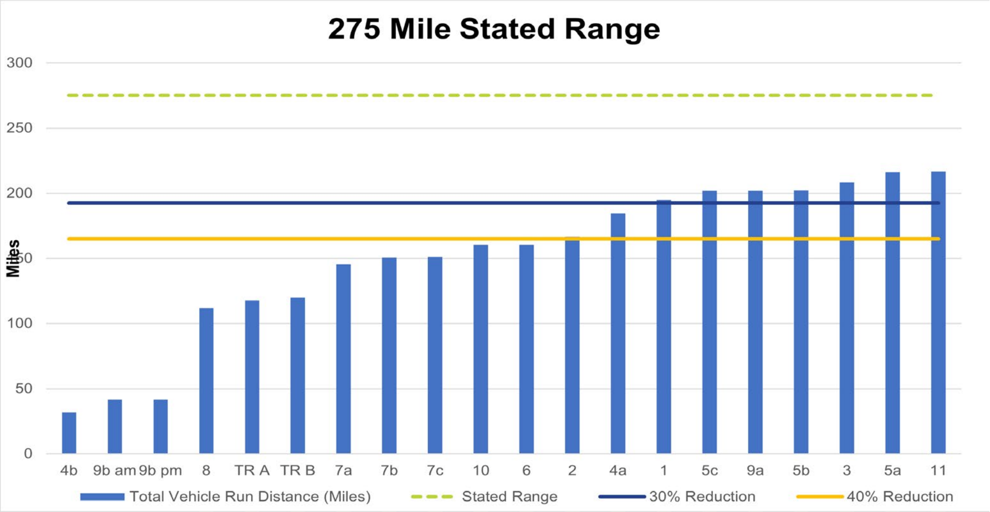
Questions

Data Backup


225 Mile Stated Range
250
200
150
100
50
0
Miles
4b 9b am 9b pm 8 TR A TR B 7a 7b 7c 10 6 2 4a 1 5c 9a 5b 3 5a 11
Total Vehicle Run Distance (Miles)
Stated Range
30% Reduction
40% Reduction


175 Mile Stated Range
250
200
150
100
50
0
Miles
4b 9b am 9b pm 8 TR A TR B 7a 7b 7c 10 6 2 4a 1 5c 9a 5b 3 5a 11
Total Vehicle Run Distance (Miles)
Stated Range
30% Reduction
40% Reduction


325 Mile Stated Range
350
300
250
200
150
100
50
0
Miles
4b 9b am 9b pm 8 TR A TR B 7a 7b 7c 10 6 2 4a 1 5c 9a 5b 3 5a 11
Total Vehicle Run Distance (Miles)
Stated Range
30% Reduction
40% Reduction


275 Mile Stated Range
300
250
200
100
50
0
Miles
4b 9b am 9b pm 8 TR A TR B 7a 7b 7c 10 6 2 4a 1 5c 9a 5b 3 5a 11
Total Vehicle Run Distance (Miles)
Stated Range
30% Reduction
40% Reduction

Natural Gas Buses

- Range of 400 miles
  - Would complete all of CAT's current blocks
- CAT could perform a 1:1 transition
- Comparable purchase price to diesel buses
  - Average purchase price is $500,000
- Cheaper to operate and maintain than diesel buses
- No public fueling stations in the area
  - CAT would have to construct an on-site facility
- Natural gas buses are considered low emission

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 and natural gas buses
  - Average purchase price of a BEB is $860,000*
  - Costs are likely to increase significantly in 2022 and beyond
- Options include depot charging, on-route charging, or a hybrid
  - 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

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, natural gas, and diesel buses
  - Average cost for a FCEB is $1,150,000
- Closest commercial providers are 300 miles away
  - New Kent DE, Kingsport TN, and Charleston WV
  - On-site hydrogen generation and constructing a hydrogen fueling station is a significant capital expenditure
- FCEBs are still in their infancy, especially for buses under 40’