ARR Fleet Electrification Plan

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Project Overview

Project Overview

- Zero waste by **2040.**
- Austin Resource Recovery Comprehensive Plan
  - Chapter 4: Sustainability (Transportation Electrification)
  - Chapter 8: Infrastructure & Facilities
- Zero Waste Commission (ZWAC) Resolution

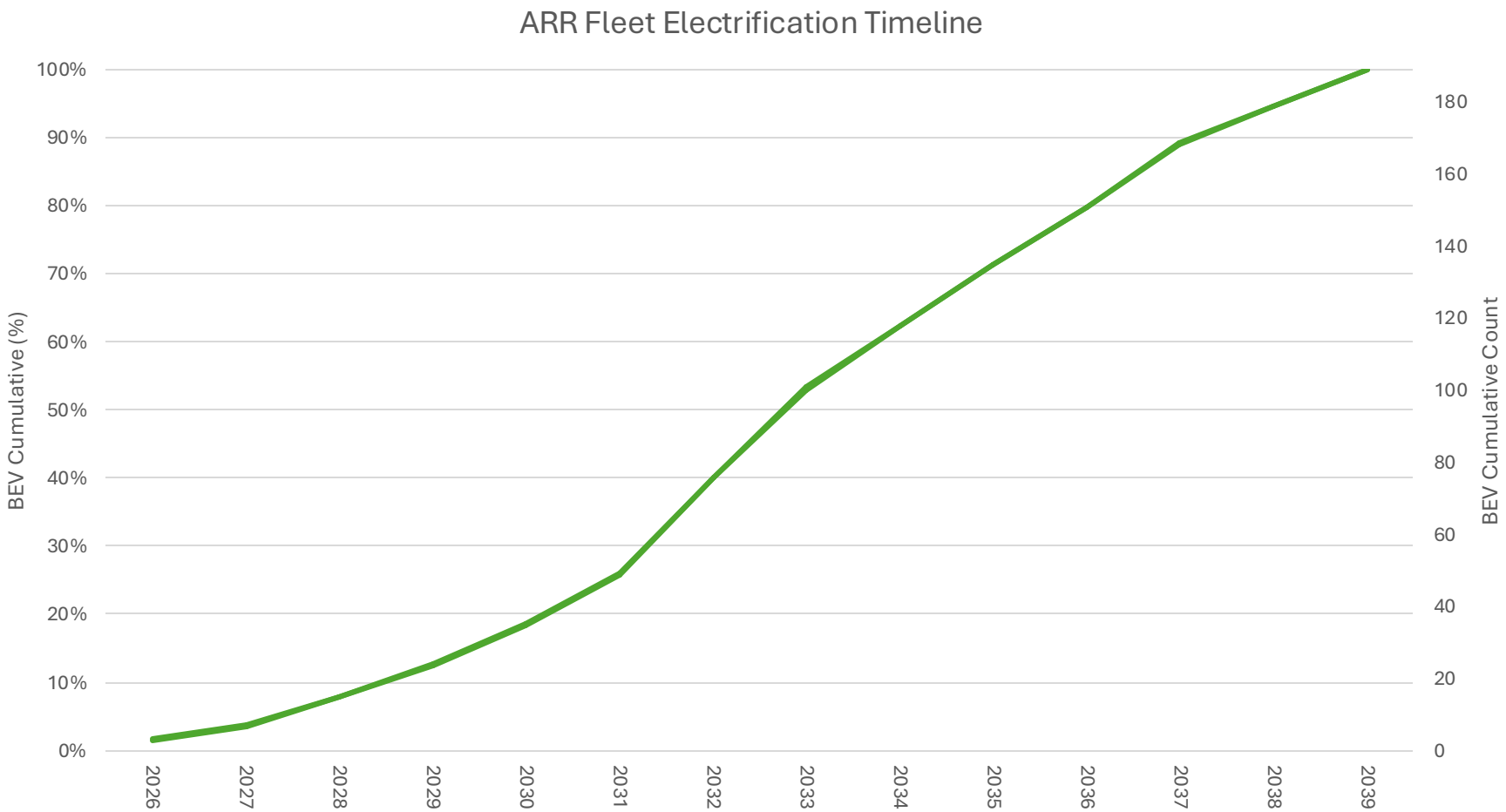
Project Outline

- **Fleet Assessment:** Identify electric alternatives for ARR's refuse trucks; Propose phased electrification schedule and vehicle models as ICEVs age out of service.
- **Charging Infrastructure:** Estimate number, type, and location of chargers; develop a buildout timeline aligned with BEV adoption.
- **Financial Analysis:** Compare acquisition, O&M, end-of-service, and infrastructure costs to assess life-cycle savings.
- **Operational Feasibility:** Evaluate route feasibility, charging locations.
- **Environmental Impacts:** Quantify GHG, air quality, health, and community co-benefits.

Fleet Assessment

Overview – ARR's Fleet Composition & EV Alternatives

- **189** front-line refuse trucks targeted for electrification
- **Current mix**: 1 BEV pilot, 2 CNG, majority diesel
- EV alternatives available across truck classes (11–33 yd, 240–500 kWh, 80–130 mi range)


ARR Fleet Electrification Timeline
BEV Cumulative (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BEV Cumulative Count
180
160
140
120
100
80
60
40
20
0
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039

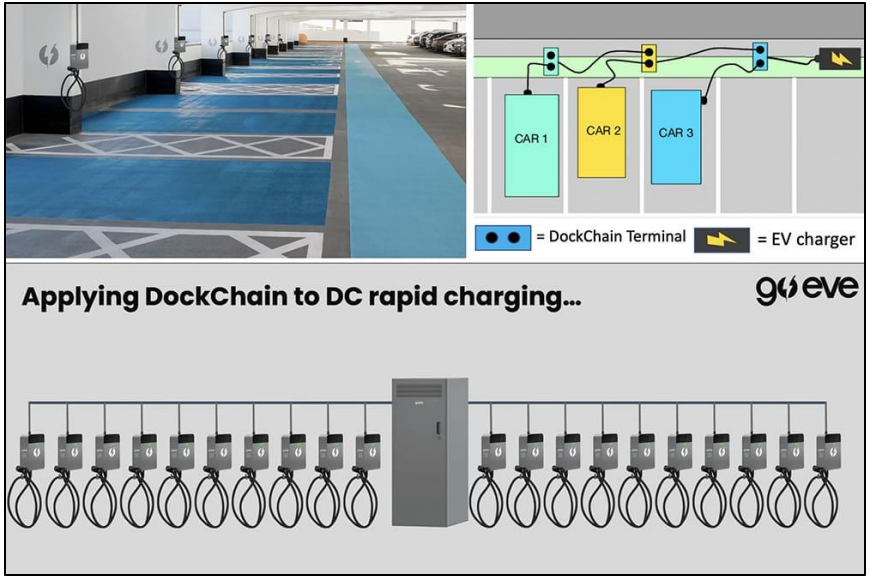
Results – ARR's Fleet Composition & EV Alternatives

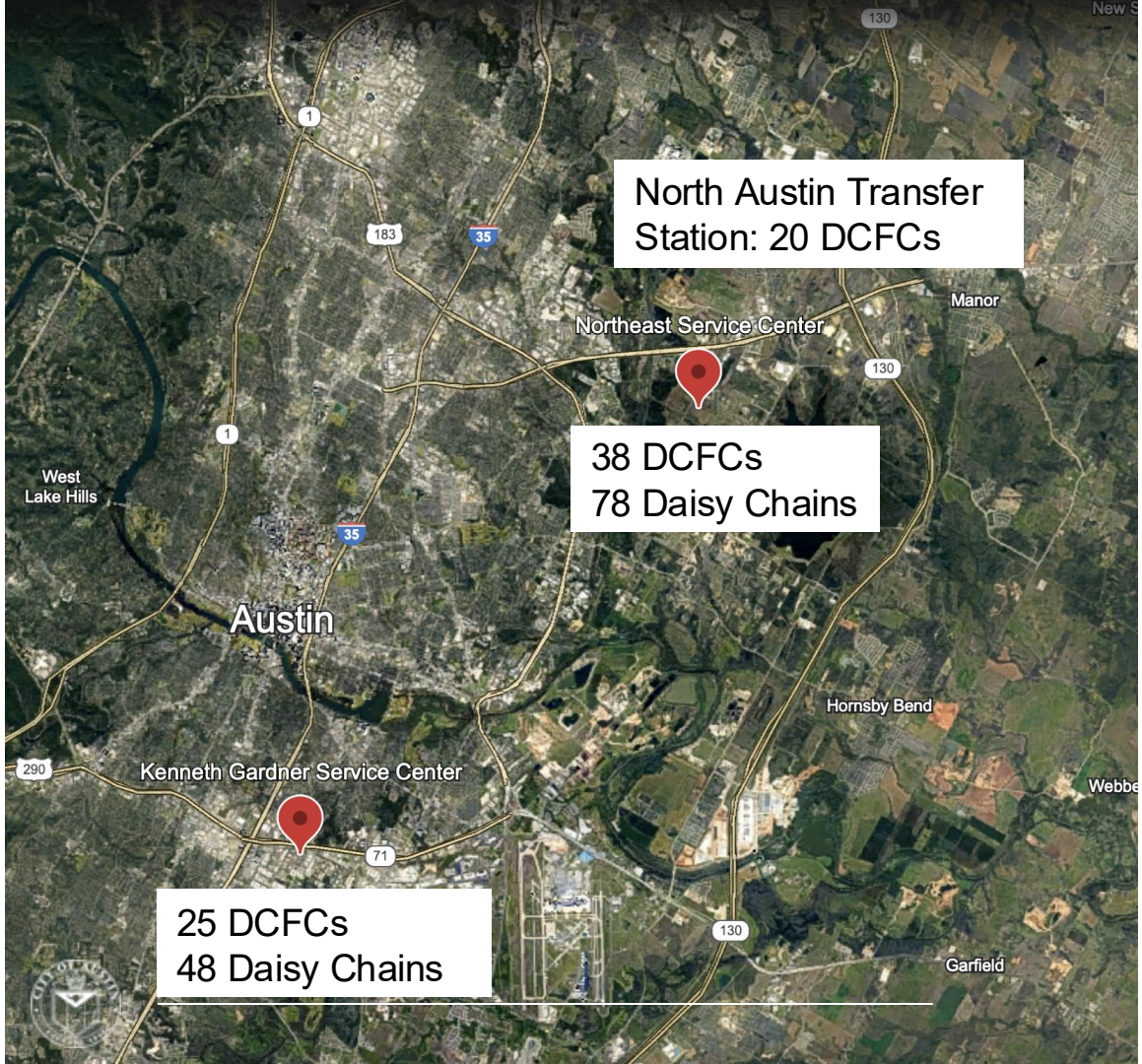
- BEV Alternatives Identified
  - 11-yd Rear Loaders: **3 EV alternatives**
  - 25-33-yd Side Loaders: **8 EV alternatives**
  - 25-33-yd Rear Loaders: **3 EV alternatives**

Charging Infrastructure

Overview – Estimation of New Charging Infrastructure Needed

- Assess charging needs based on the 60/40 fleet split between NESC & KGSC. Also consider possible transfer station.
- Compare technology options: all-DC fast charging vs. hybrid daisy-chain approach.
- Plan phased buildout aligned with fleet adoption and cost efficiencies.
- All infrastructure funding and associated O&M costs to be covered by Fleet Mobility Services.

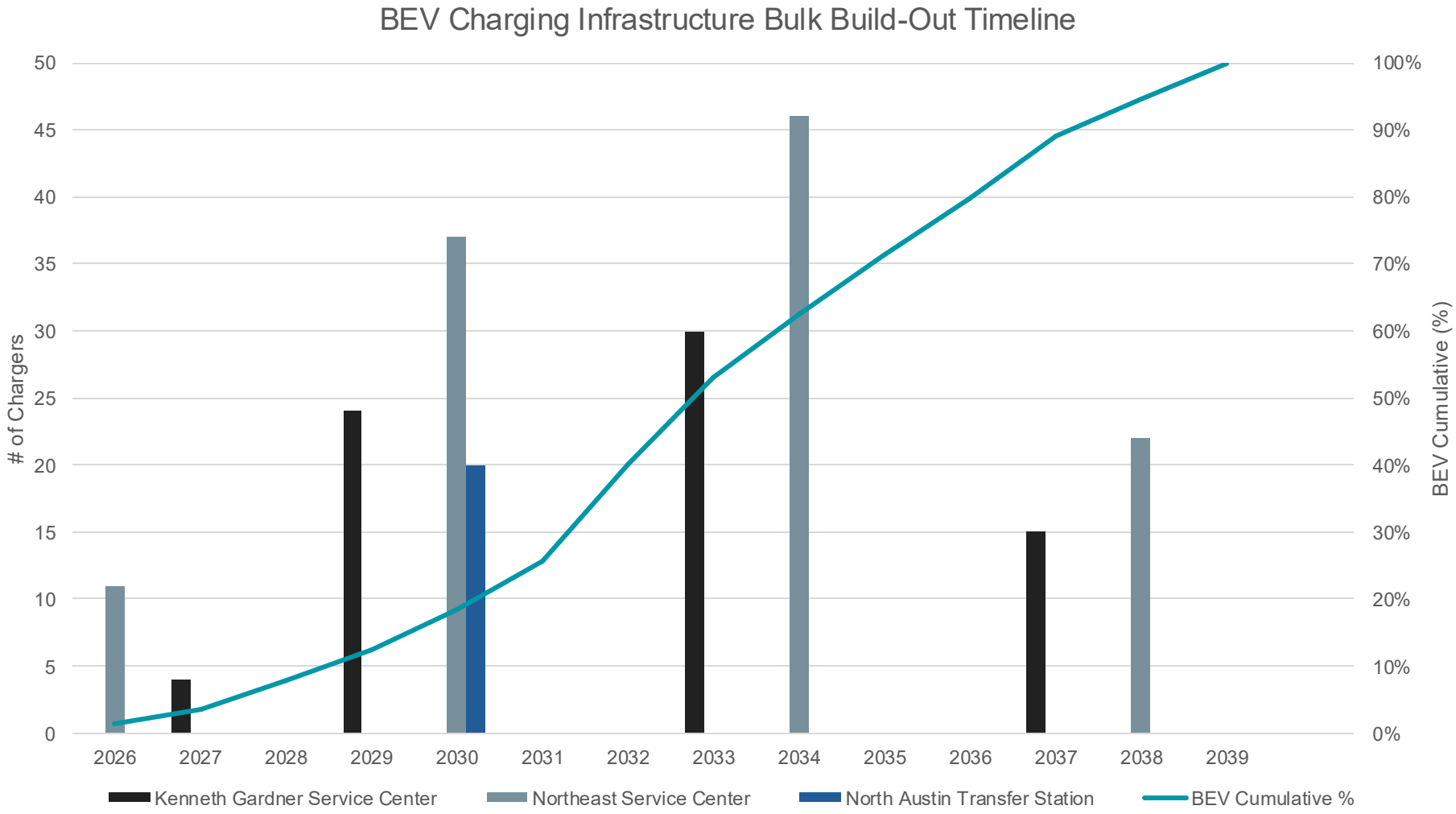




Proposed Charging

Funded charging

- NESC: 11 funded DC fast chargers
- KGSC: 4 funded DC fast chargers
- Additional chargers funded by Fleet Mobility Services
- North Austin Transfer Station


BEV Charging Infrastructure Bulk Build-Out Timeline
# of Chargers
BEV Cumulative (%)
0
5
10
15
20
25
30
35
40
45
50
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
Kenneth Gardner Service Center
Northeast Service Center
North Austin Transfer Station
BEV Cumulative %

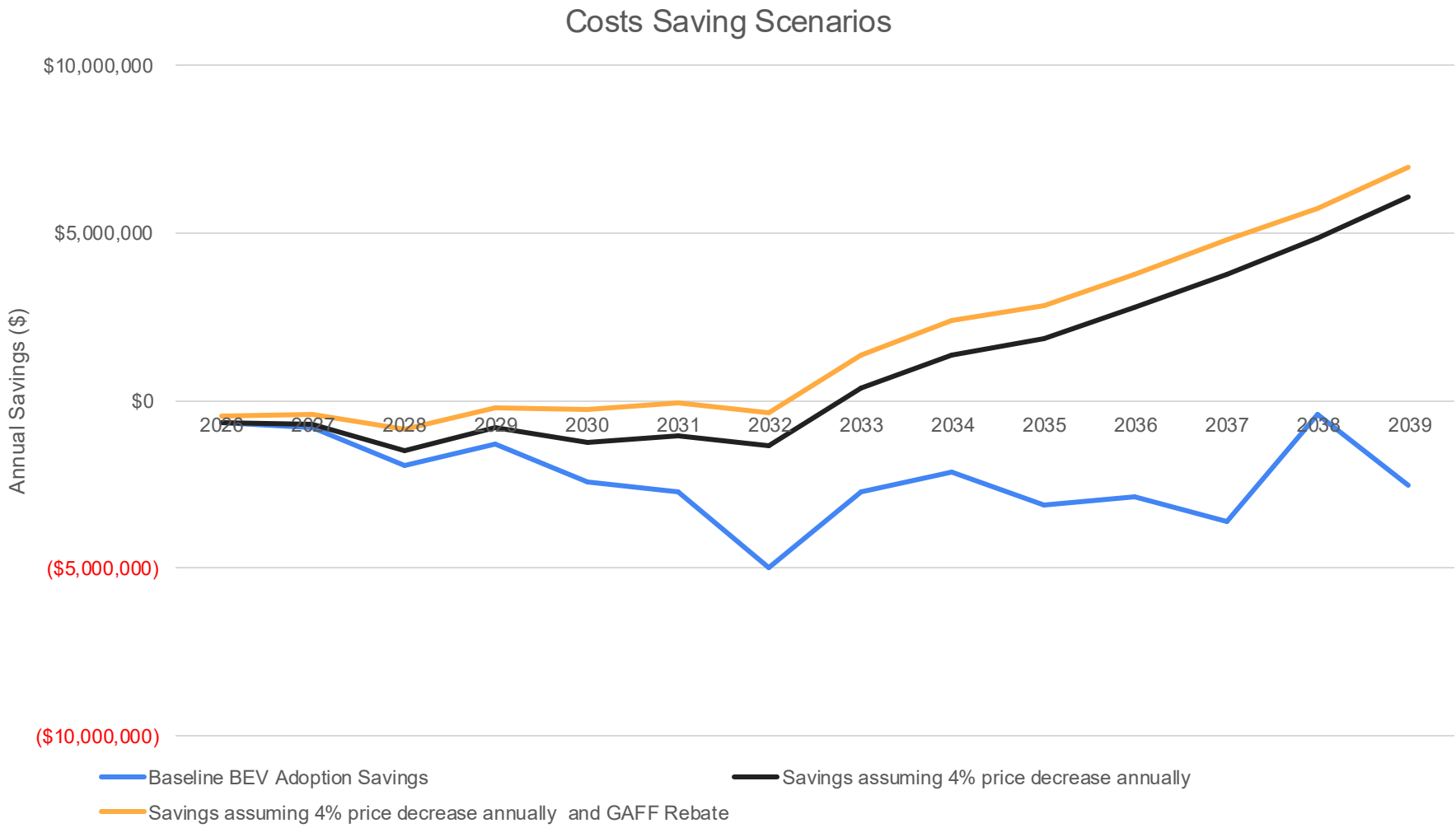
Financial Analysis

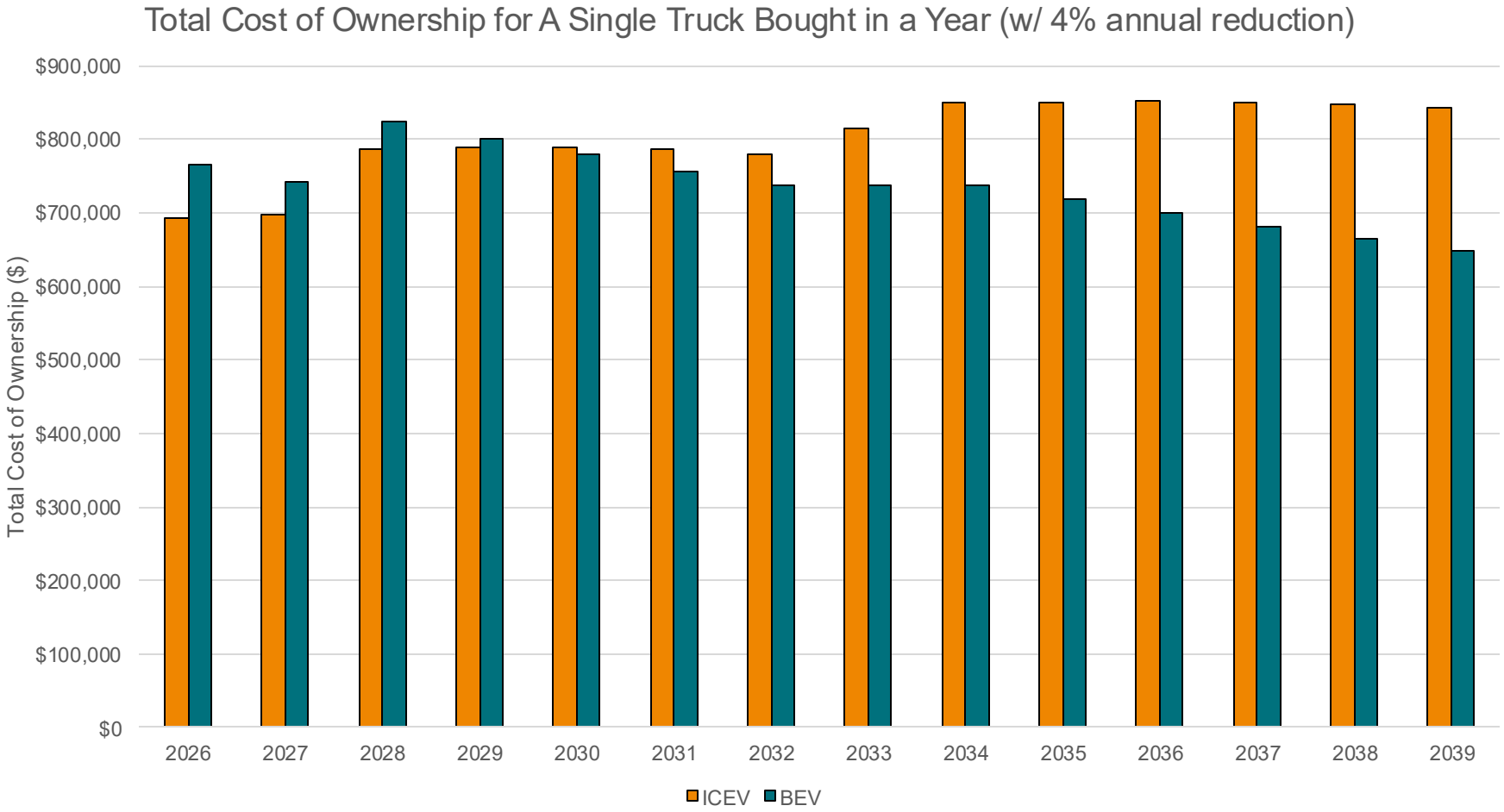
Overview – Financial Analysis of EV Transition

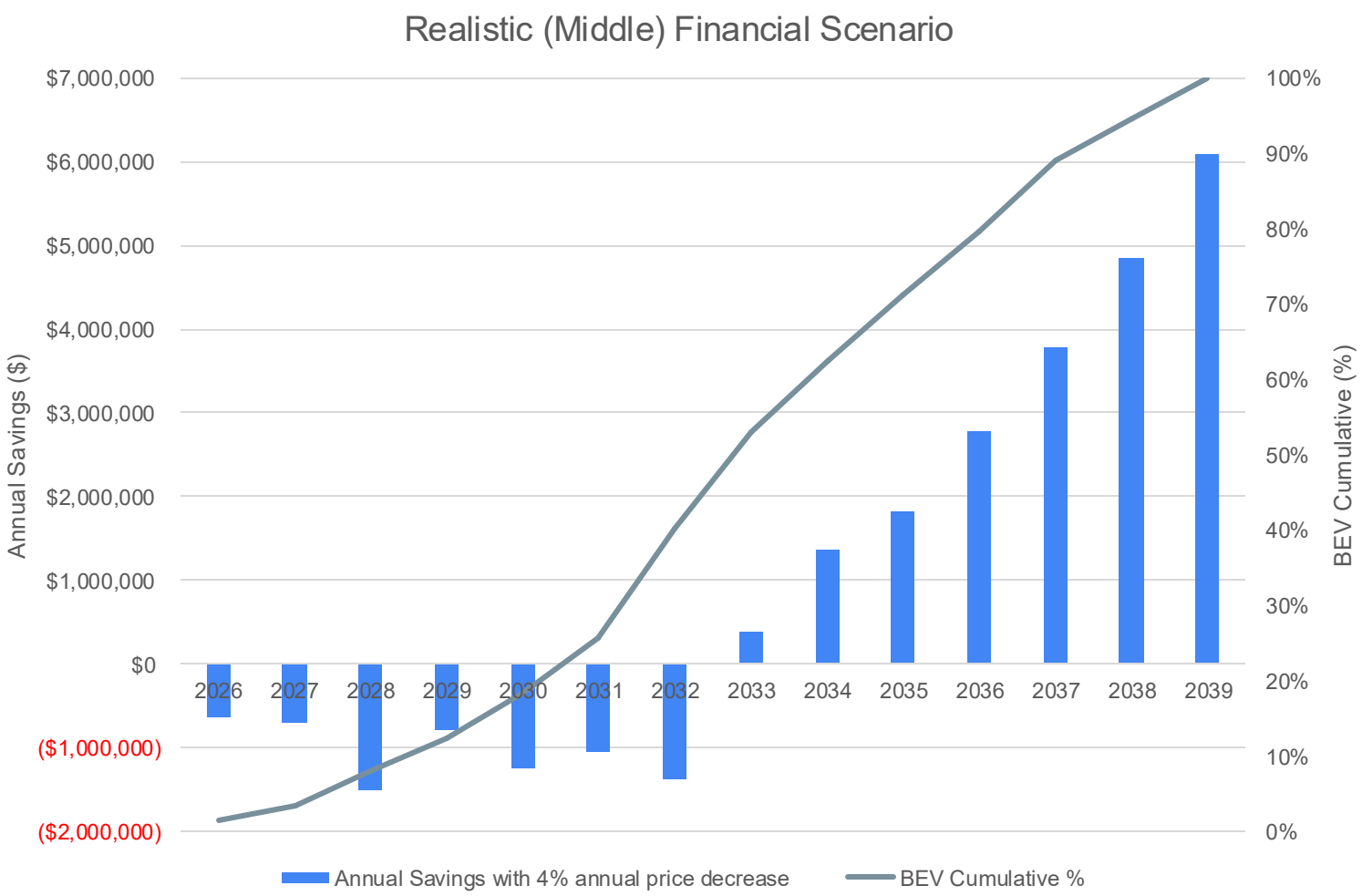
- Model phased replacement from ICEVs to BEVs aligned with ARR's budget and procurement schedule.

- Analyze total cost of ownership (TCO) for ICEVs vs. BEVs, factoring capital, fuel, maintenance, and resale.

Financial Analysis of EV Transition - Scenarios
Simple BEV Truck Adoption
4% Annual Reduction
4% Annual Reduction + Governmental Alternative Fuel Fleet Grant Program (GAFF)


Costs Saving Scenarios
$10,000,000
$5,000,000
$0
($5,000,000)
($10,000,000)
Annual Savings ($)
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
Baseline BEV Adoption Savings
Savings assuming 4% price decrease annually
Savings assuming 4% price decrease annually and GAFF Rebate

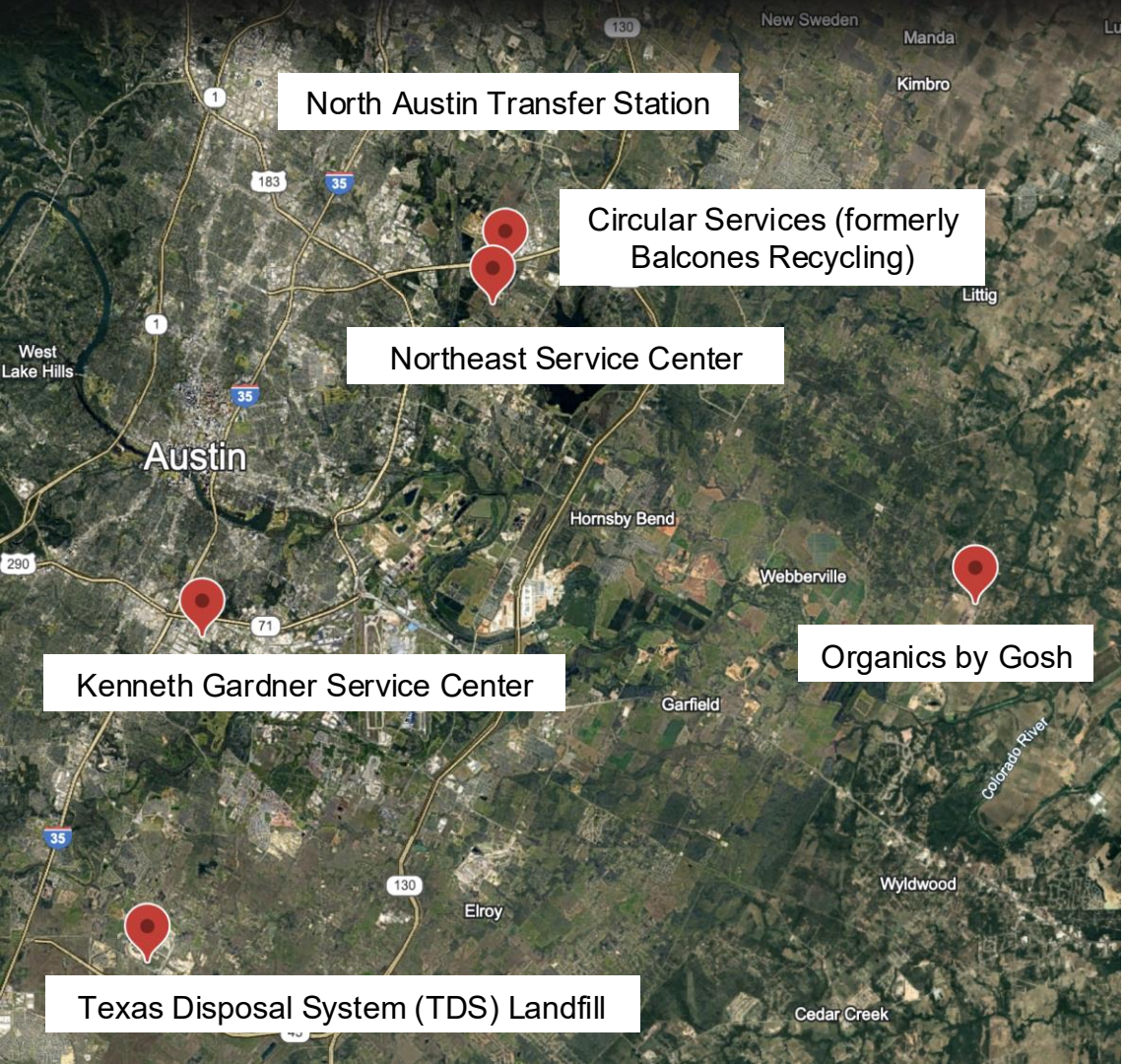

Total Cost of Ownership for A Single Truck Bought in a Year (w/ 4% annual reduction)
$900,000
$800,000
$700,000
$600,000
$500,000
$400,000
$300,000
$200,000
$100,000
$0
Total Cost of Ownership ($)
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
ICEV
BEV


Realistic (Middle) Financial Scenario
$7,000,000
$6,000,000
$5,000,000
$4,000,000
$3,000,000
$2,000,000
$1,000,000
$0
($1,000,000)
($2,000,000)
Annual Savings ($)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BEV Cumulative (%)
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
Annual Savings with 4% annual price decrease
BEV Cumulative %

Operational Feasibility

Overview – Operational Feasibility

- Two-week snapshot (June 1 to 27, 2025) analyzed for vehicle work cycles (~804 routes total)
- Three representative routes simulated: recycling (North), garbage (East), compost (Southwest)
- Evaluation included mileage, duration, arm lifts, compactions, landfill/unloading events
- Battery performance factors considered: load weight, terrain, climate control, regenerative braking



Map of locations significant to ARR's collection route including the Texas Disposal System (TSD), KGSC, NESC, Balcones Recycling, Organics by Gosh, and North Austin Transfer Station.

A. Main Engine @ 90% Efficiency for Recycling Route (RWBU50)				
	Speed	Load	Milage	kWh
Collection Route	Low	Half Loaded	17.8	47
Collection Route/ Yard to Dump Site	High	Full Load	26	74
Dump Site to Collection Route/ Yard	High	No Load	35.2	88
Total			**79**	**210**
B. Energy Consumption @ 70% Pump Efficiency				
			Number of	kWh
Lifts			869	43
Dumps			2	1
Compaction			17	5.44
Total				**50**
C. EV Cabin Energy Needs				
			Hours	kWh
Air Compressor			11.85	35.6
Total Energy Consumption (A+B+C)				295
Less 10% energy from regenerative breaking - Main Engine (A)				(21)
5% of energy from Austin terrain				10
Total Energy Consumption				285
Battery Capacity				**376**
Battery State of Charging Remaining				**24%**

Example: Recycling Route

Compact service area with high number of stops; energy use for hauling totals 285 kWh

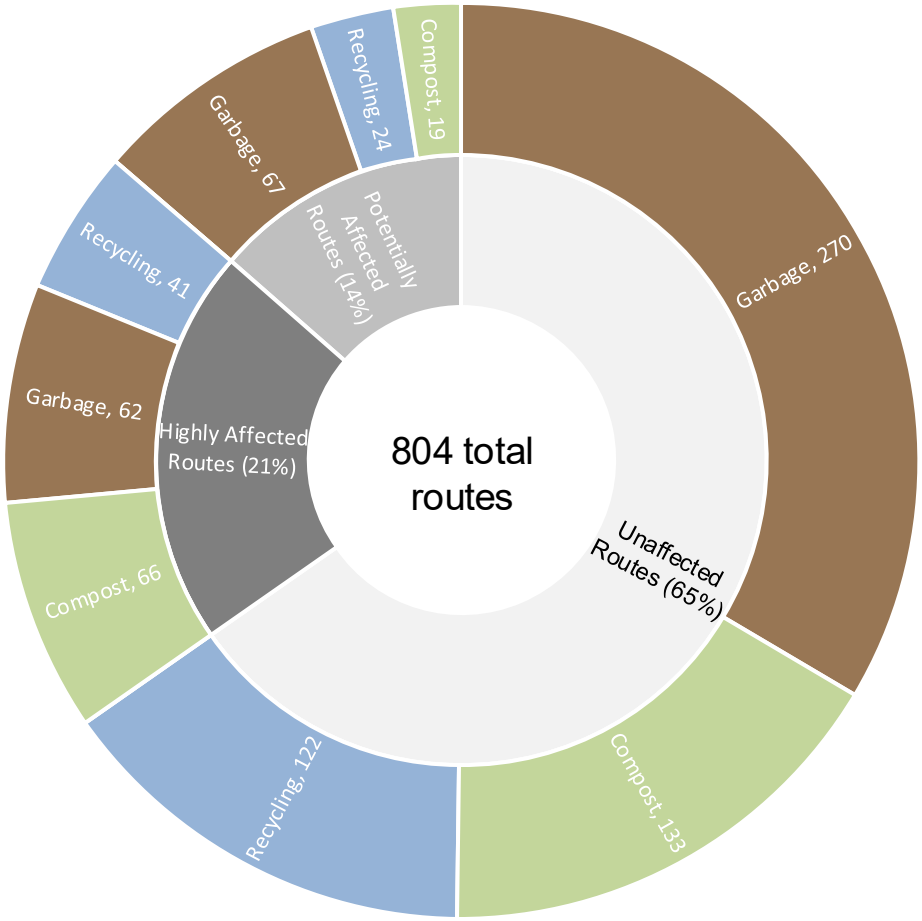
Using a 375 kWh Mack LR EV, route completes with ~ 24% charge remaining → strong feasibility without mid-route charging

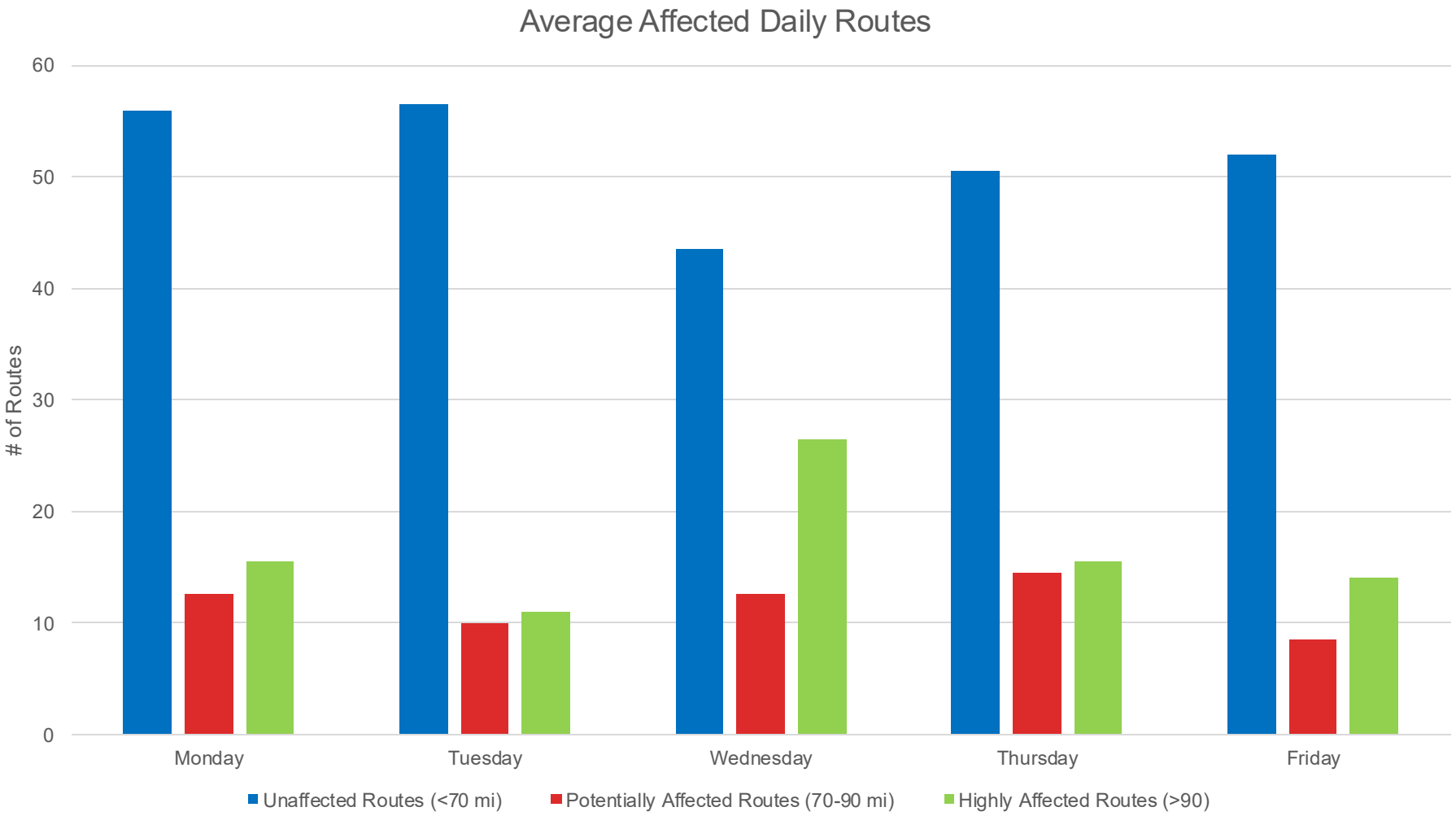
Mileage Thresholds Informed by Route Analysis

- Best practice: vehicles should return to depot with 15%-20% charge.
- The detailed route analysis was used to gauge the overall impact of electrifying ARR's fleet based on current routes.
- Mileage thresholds:

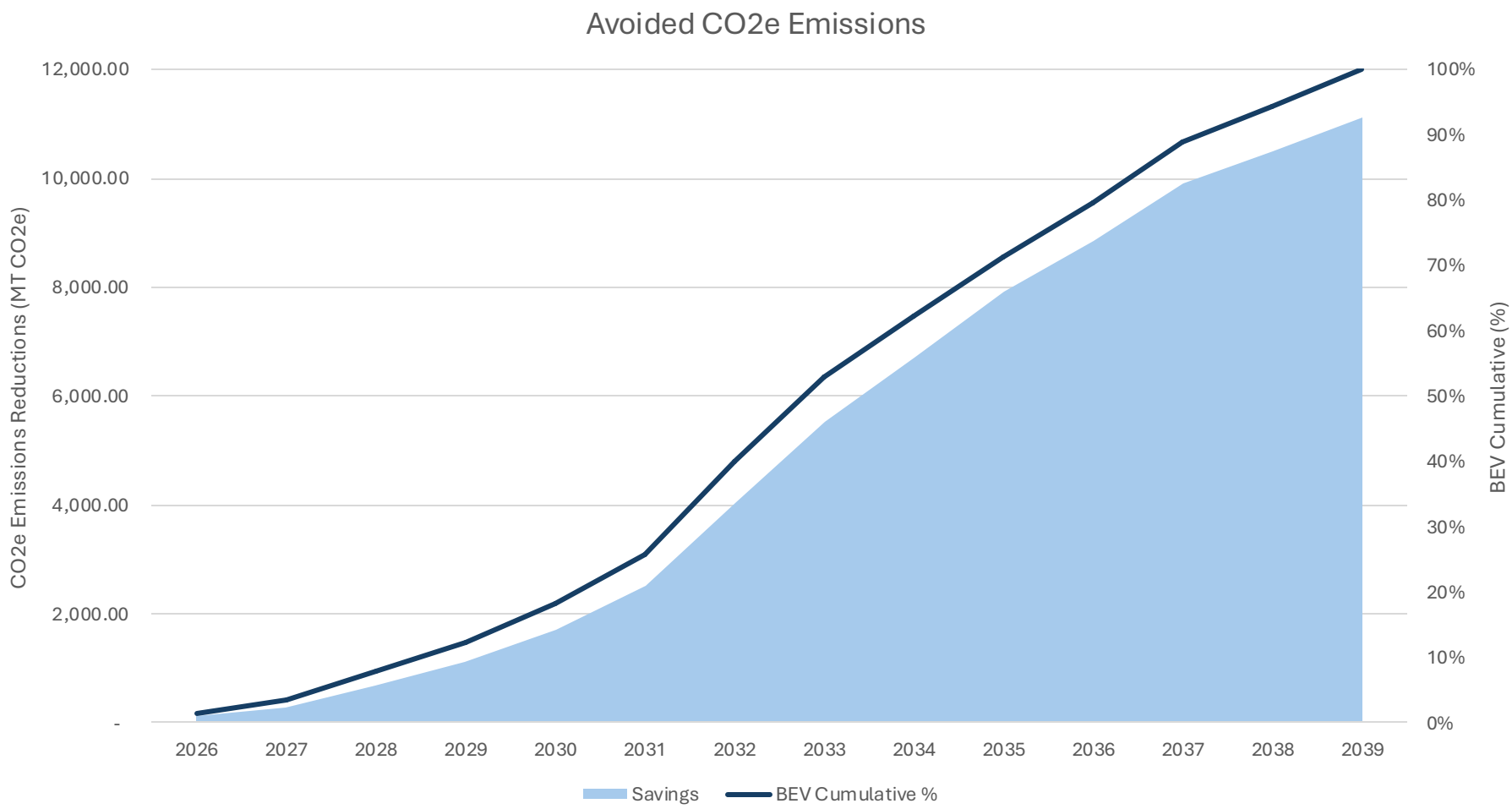
Unaffected Routes: <70 miles
Potentially Affected Routes: 70-90 miles
Highly Affected Routes: >90 miles

ARR Fleet Electrification Impact on Existing Routes




Average Affected Daily Routes
60
50
40
30
20
10
0
# of Routes
Monday
Tuesday
Wednesday
Thursday
Friday
Unaffected Routes (<70 mi)
Potentially Affected Routes (70-90 mi)
Highly Affected Routes (>90)

Environmental Impacts


Avoided CO2e Emissions
12,000.00
10,000.00
8,000.00
6,000.00
4,000.00
2,000.00
-
CO2e Emissions Reductions (MT CO2e)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
BEV Cumulative (%)
2026
2027
2028
2029
2030
2031
2032
2033
2034
2035
2036
2037
2038
2039
Savings
BEV Cumulative %

1 diesel refuse truck = 13 sedans

x 189 diesel refuse trucks

Co-Benefits Risk Assessment (COBRA)

- **Methodology:** Based on EPA's COBRA model using avoided NO_x and PM emissions
- **Quantified Health Impacts:** Cumulative benefits from 2026–2039 estimated at $505,000–$751,000
- **Avoided Illnesses:** Reductions in infant mortality, respiratory, and cardiovascular illnesses
- **Pollutant-Specific Benefits:** $195,000–$441,000 from PM exposure; $223,000 from avoided ozone-related deaths

Key takeaways

- Begin vehicle replacements in 2026 to align with retirements
- Secure funding to offset incremental vehicle and infrastructure costs
- Prioritize DCFC and daisy chain chargers at NESC to support longer routes needing mid-route charging
- Track route performance, energy use, and battery range to ensure operational feasibility

Thank you!