Metropolitan Atlanta Rapid Transit Authority (MARTA): FTA Zero-Emission Fleet Transition Plan

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Introduction

The Metropolitan Atlanta Rapid Transit Authority (MARTA) developed this Zero-Emission Fleet Transition Plan to meet the requirements of 49 U.S.C. 5339(c)(3)(D) for applicants to the *FY2023 Low or No Emission Grant Program (Low-No)*. This fleet transition plan was developed specifically for this application and includes reference to the project(s) requesting FY23 funding.

The plan is divided into six sections, addressing each of the following elements outlined by Federal Transit Administration (FTA):

1. **Fleet Assessment:** Demonstrate a long-term fleet management plan with a strategy for how the applicant intends to use the current request for resources and future acquisitions.
2. **Funding Needs Assessment:** Address the availability of current and future resources to meet costs for the transition and implementation.
3. **Policy Assessment:** Consider policy and legislation impacting relevant technologies.
4. **Facilities Assessment:** Include an evaluation of existing and future facilities and their relationship to the technology transition.
5. **Partnership Assessment:** Describe the partnership of the applicant with the utility or alternative fuel provider.
6. **Workforce Analysis:** Examine the impact of the transition on the applicant's current workforce by identifying skill gaps, training needs, and retraining needs of the existing workers of the applicant to operate and maintain zero-emission vehicles and related infrastructure and avoid displacement of the existing workforce.

Element 1: Fleet Assessment

Transit Fleet Assessment Overview

The Fleet Assessment determines a projected timeline for replacing existing transit buses and increasing the fleet of mobility buses with zero-emission buses (ZEB) that stays consistent with MARTA's current fleet management plan. This assessment also includes a projection of vehicle capital costs over the transition timeline.

MARTA is comprised of 517 buses, primarily split between diesel and compressed natural gas (CNG) vehicles, with six battery electric buses (BEB) that entered the fleet in 2021. These diesel and CNG buses were introduced to the fleet between 2010 and 2022. The average vehicle age in this fleet is 5 years.

MARTA operates 110 fixed routes in its service area, which comprises the entirety of Fulton, DeKalb, and Clayton Counties in the Atlanta, Georgia metropolitan statistical area (MSA). The first step in the Fleet Assessment is determining the schedule for replacing MARTA's current fleet with ZEBs. For the purpose of the FY23 Low/No application and based on MARTA's goals and current fleet replacement plan MARTA developed the following Annual ZEB Procurement Schedule presented by depot below in **Table 1.**

Table 1: Annual ZEB Procurement Schedule – Transit Fleet

Year	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Number of Buses Scheduled to Enter Service	0	0	51	45	51	45	51	45	45	45	45	45	45	45	45	51	45	51	45
Number of ZEBs Scheduled to Enter Service	0	0	6	10	21	20	31	45	45	45	45	45	45	45	45	51	45	51	45
ZEB % of New Buses	0	0	12	22	41	44	61	100	100	100	100	100	100	100	100	100	100	100	100

In this schedule, vehicles are replaced with a BEB using the following criteria:

- The vehicle has met the end of its useful life
- Charging infrastructure is in place
- Technicians supporting the maintenance of the BEB fleet have completed training

This assessment assumes that the fleet will remain the same size throughout the period of transition to a zero-emission fleet. MARTA aims to replace its entire diesel vehicle fleet by 2032, consistent with its retirement schedule for those vehicles.

Based on the Annual ZEB Procurement Schedule, MARTA began to procure zero-emission buses in 2021 under its 2019 Low/No grant award. MARTA plans to transition its fleet to 100% zero-emission vehicles by 2040 per its vehicle retirement/replacement schedule. MARTA's FY22 Low-No project is reflected in the 2026 procurement year at the Perry Depot. At this time, MARTA only has specific plans to procure BEBs for its zero-emission vehicle fleet but is committed to remaining nimble to additional zero-emissions technologies as they become commercially available for MARTA fleet vehicles, including fuel cell electric buses and hydrogen fueling infrastructure.

Mobility Fleet Assessment Overview

MARTA also operates 240 demand response mobility vehicles in its service area, which comprises the entirety of Fulton, DeKalb, and Clayton Counties in the Atlanta, Georgia metropolitan statistical area (MSA). Mobility ridership has shown an increase of 37.2% from the previous year with projections of further increases anticipated.

For the purpose of the FY22 Low-No application and based on MARTA's goals and current fleet management plan MARTA has developed the following Annual mobility ZEB Procurement Schedule presented below in **Table 2.**

Table 2: Annual ZEB Purchase Schedule – Mobility Fleet

Year	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Number of Buses Scheduled to Enter Service	0	0	35	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Number of ZEBs Scheduled to Enter Service	0	0	35	0	35	20	35	20	25	30	35	40	45	50	55	55	55	55	55
ZEB % of New Buses	0	0	100	0	64	36	64	36	45	55	64	73	82	91	100	100	100	100	100

In this schedule, vehicles are replaced with a BEB using the following criteria:

- The vehicle has met the end of its useful life
- Charging infrastructure is in place
- Technicians supporting the maintenance of the BEB fleet have completed training

This assessment assumes that the fleet will remain the same size throughout the period of transition to a zero-emission fleet.

Based on the Annual ZEB Procurement Schedule, MARTA plans to transition its fleet to 100% zero-emission vehicles by 2040 per its vehicle retirement/replacement schedule. At this time, MARTA only has specific plans to procure BEBs for its zero-emission vehicle fleet but is committed to remaining nimble to additional zero-emissions technologies as they become commercially available for MARTA fleet vehicles, including fuel cell electric buses and hydrogen fueling infrastructure.

Key Results

Figures 1 – 2 show MARTA's projected purchases of transit and mobility buses by year including the number and type of bus propulsion through 2040. The proposed FY23 Low-No project is reflected in **Figure 2,** with MARTA procuring 35 mobility BEB's.

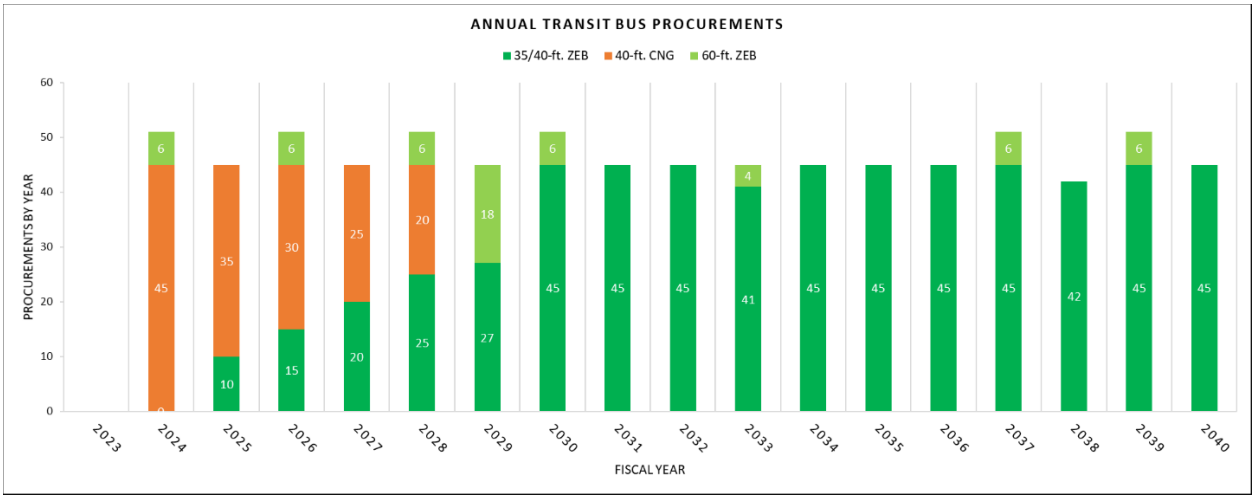

Figure 1 – Projected Transit Bus Procurements

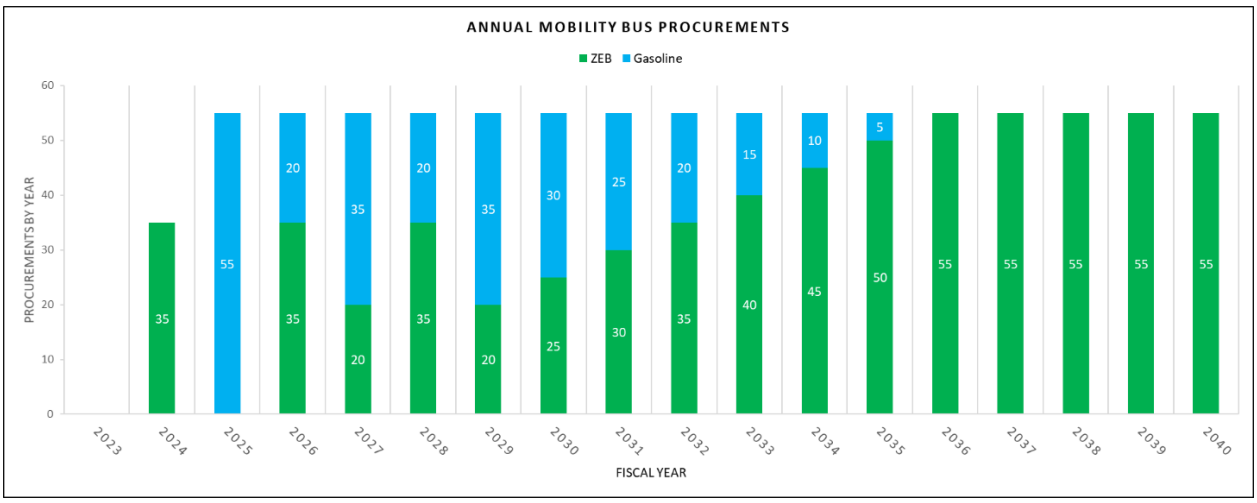

Figure 2 – Projected Mobility Bus Procurements

Figures 3 - 4 depict MARTA's proposed annual transit fleet composition through 2040 as it phases out previous vehicle propulsion technologies for ZEBs. By 2040, the agency's fleet is 100% ZEBs.

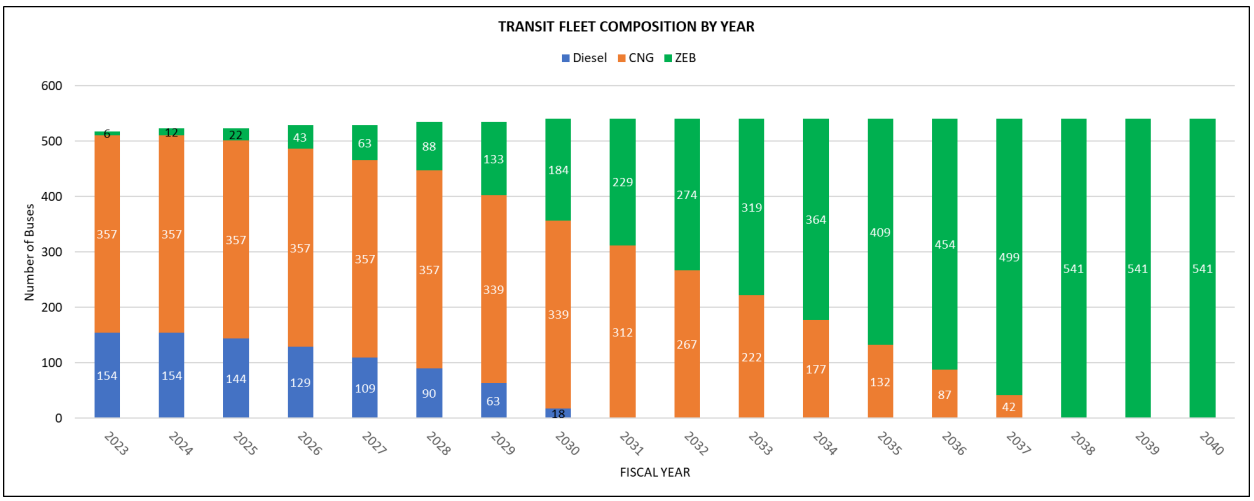

Figure 3 – Annual Fleet Composition – Transit Fleet

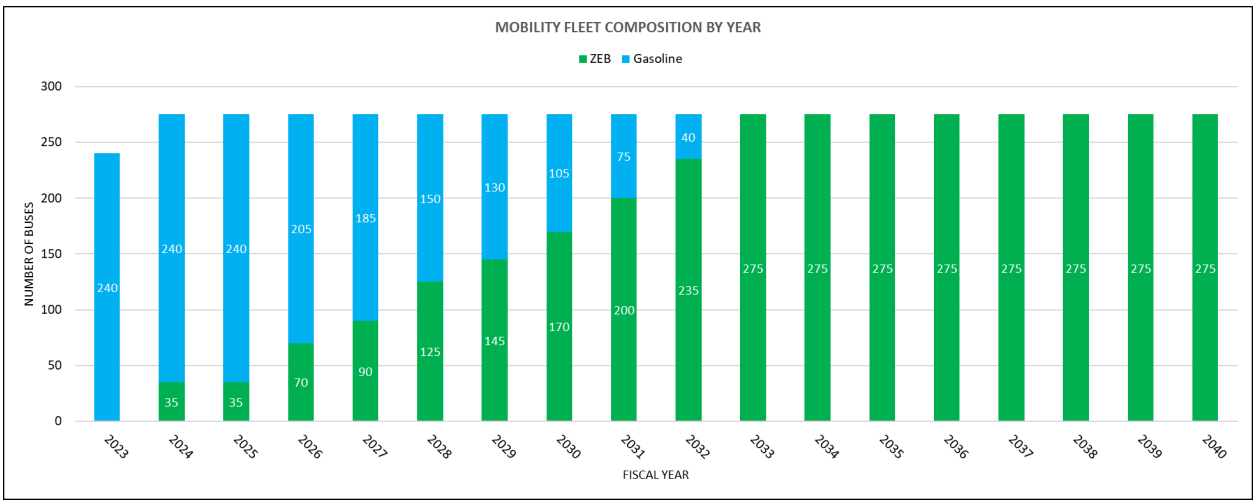

Figure 4 – Annual Fleet Composition – Mobility Fleet

Cost Assumptions

Key assumptions for vehicle costs for the Zero-Emission Fleet Transition Plan are as follows:

- Vehicle costs are based on the agency's most recent procurement price for standard vehicle propulsion technologies and industry averages for zero-emission technologies;
- Vehicle costs are inclusive of estimates for configurable options and taxes;
- Vehicle cost includes estimate for extended battery warranty, allowing for a mid-life battery replacement;
- Vehicle costs do not include inflation.

Figures 5 - 6 show the annual capital costs for zero-emissions vehicles purchased in a given year through 2040. The estimated total cost for transit and mobility zero-emissions vehicles over the designated transition period is $996 million. Costs are incurred from the annual ZEB purchases laid out in the fleet replacement plan.

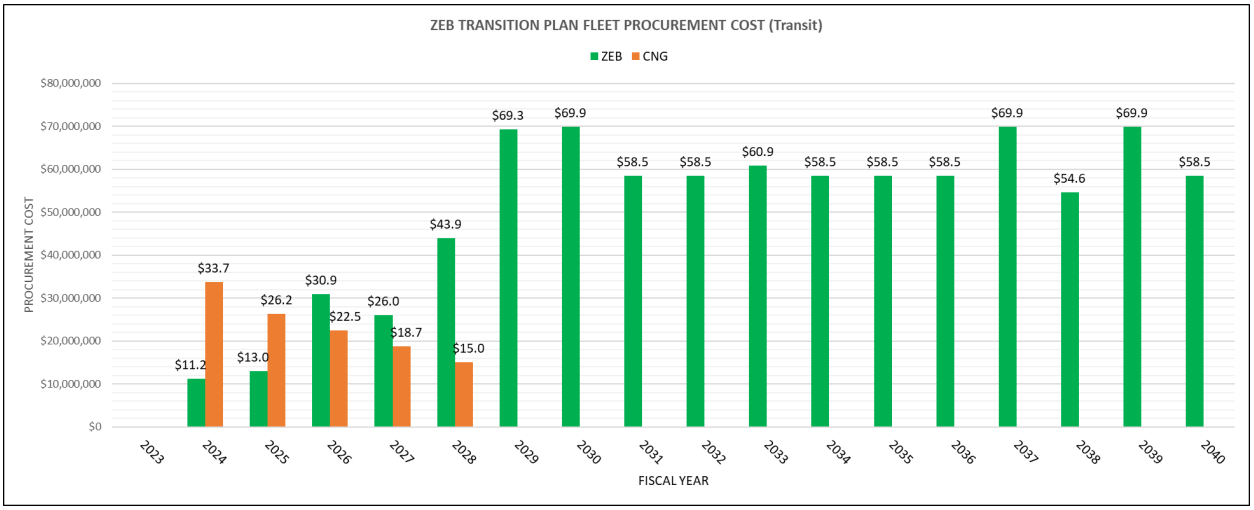

Figure 5 – Annual Capital Costs – Transit Fleet

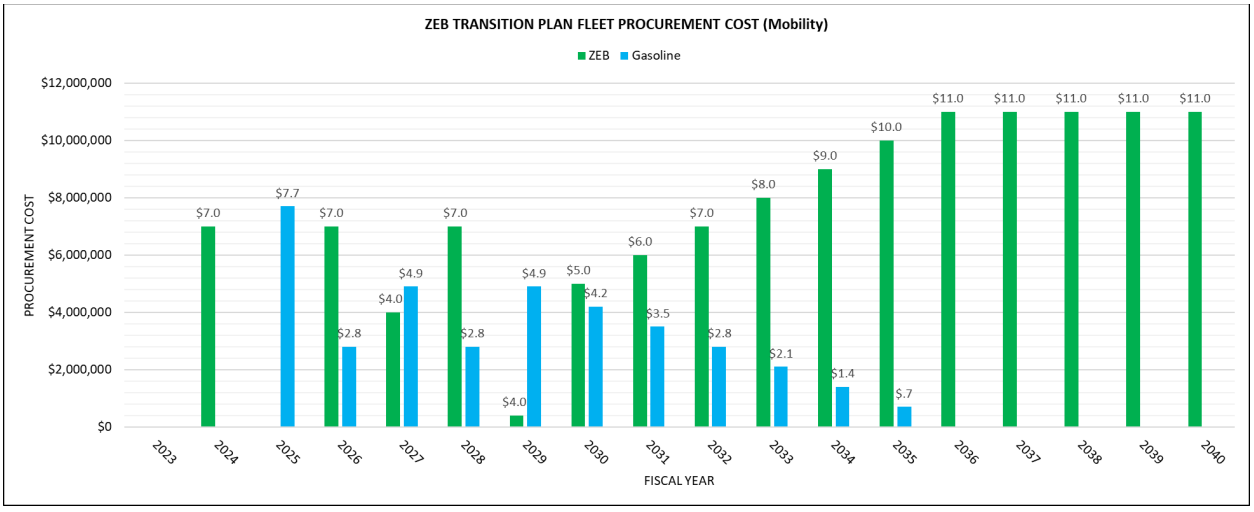

Figure 6 – Annual Capital Costs – Mobility Fleet

Conclusion

MARTA expects to reach full transition to a zero-emission fleet by 2040. The expected total capital cost of vehicles for the transition to a ZEB fleet is estimated at $996 million.

Element 2: Funding Needs Assessment

Funding Assessment Overview

MARTA allocates funds based on an established procurement timeline determined by the useful life of its buses. Transitioning to a zero-emission bus fleet increases overall fleet costs because of the incremental cost of zero-emission buses, the installation of new infrastructure, and required modifications to maintenance facilities. The current market cost of zero-emission buses is between $1,000,000 and $1,900,000, which is approximately $250,000 to $1,150,000 more expensive than diesel buses. Additionally, the necessary infrastructure to support these zero-emission buses adds to the financial burden of transitioning to a zero-emission fleet.

For the purposes of the Zero-Emission Fleet Transition Plan, vehicle costs and infrastructure costs are assessed individually in the Fleet and Facilities Assessments. The results of those cost assessments are compiled here as total costs and then compared to MARTA's budget to better understand funding gaps and needs.

MARTA Funding Needs

MARTA currently funds its bus procurement, operations, and maintenance through a combination of sources, including a MARTA-specific sales tax, FTA formula programs, other USDOT grant programs such as CMAQ. The agency received a 2019 LowNo grant award to procure and deploy its first six BEBs, and Congressionally-directed spending in the 2022 Consolidated Appropriations Act to support procurement of additional BEBs.

Over the course of the transition period, MARTA plans to deploy 535 BEBs. These vehicles will require new charging infrastructure currently assumed at a 2:1 ratio of buses to 150 kW chargers. For the purposes of the 2023 Low/No proposal, MARTA is requesting chargers on a 1:1 ratio pending further analysis and block assignment. However, MARTA expects to add dispensers to those chargers at a later date so they can serve additional BEBs. MARTA will also need to perform a more comprehensive assessment of service needs to determine on-route charging potential and needs. MARTA's 2019 LowNo award funded the procurement and deployment of one on-route pantograph charger, and MARTA will consider adding more at other locations to support service and reduce depot charging needs.

To achieve these goals and move towards a successful deployment of zero-emission buses, MARTA projects will require an estimated $1.1 billion in funding to cover the procurement of vehicles and infrastructure during the transition time period. This cost estimate includes the necessary costs for the transition, as determined via the cost analyses completed for the Fleet and Facilities Assessments.

Available Funding Resources & Resulting Funding Shortfalls

Based on the funding needs identified above and an assessment of MARTA's current projections, MARTA must identify resources that can cover this funding gap. Traditional formula funding and MARTA jurisdiction sales taxes will provide support for the transition to a zero-emission fleet (e.g., using formula funds to cover the base price of a zero-emission bus and applying for Low-No funds for the incremental cost difference), but it is likely MARTA will require additional funding to offset the higher costs associated with zero-emission technology.

MARTA is prepared to pursue funding opportunities at the federal, state, and local level, as necessary and as available.

Federal Funding sources MARTA is considering include:

- United States Department of Transportation (USDOT)
    - Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants
    - Multimodal Project Discretionary Grant - Mega
- Federal Transportation Administration (FTA)
    - Bus and Bus Facilities Discretionary Grant
    - Low- or No-Emission Vehicle Grant
    - Metropolitan & Statewide Planning and Non-Metropolitan Transportation Planning
    - Urbanized Area Formula Grants
    - State of Good Repair Grants
    - Flexible Funding Program – Surface Transportation Block Grant Program
- Federal Highway Administration (FHWA)
    - Congestion Mitigation and Air Quality Improvement Program
    - Carbon Reduction Fund Program
- Environmental Protection Agency (EPA)
    - Environmental Justice Collaborative Program-Solving Cooperative Agreement Program
- Congressionally-directed spending

MARTA is also looking to state funding, namely the Georgia Transit Trust Fund, for additional funding to support its fleet transition goals. The Georgia Public Service Commission also authorized in 2019 a make-ready program through Georgia Power to fund electrical infrastructure upgrades in support of electric vehicle charging equipment. MARTA will seek to leverage this funding as well for depot infrastructure upgrades.

Element 3: Policy Assessment

Policy Assessment Overview

Policies and regulations supporting the transition to zero-emission are proliferating as the efforts to decarbonize the transportation sector expand. MARTA is monitoring the implementation of relevant policies and legislation. While relevant funding programs are considered in the Funding Needs Assessment above, policies and regulations that direct aspects of zero-emission transit deployments beyond funding are considered in this section. MARTA will thoroughly assess all relevant policies and legislation throughout the fleet transition.

Alignment with Federal Priorities and Policies

With the passage of the *Bipartisan Infrastructure Law* and *Executive Order 14008: Tackling the Climate Crisis at Home and Abroad*, the federal government has set a renewed focus on zero-emission transit. MARTA's goal to fully transition its fleet to zero-emission vehicles supports the federal administration priorities of safety, modernization, climate, and equity for public transportation. MARTA's zero-emission transition will improve safety by ensuring fleet state-of-good repair and depot electrification in line with systems safety best practices, modernization by adopting state-of-the-art vehicle technologies to remain competitive with single-occupancy vehicles, and climate objectives by displacing greenhouse gas emissions. This transition will also support equity objectives by ensuring all corners of MARTA's three-county service area have access to modern public transportation, and displace the noxious tailpipe emissions to which they face disproportionate exposure.

Georgia Policies & Goals

While the State of Georgia has not formally adopted a climate goals, the state has made progress in reducing greenhouse gas emissions from 2005, primarily by phasing out coal-fired power plants. The transportation sector is now the largest source of greenhouse gas emissions. The Georgia Department of Transportation (GDOT) added implementation of zero-emission transit vehicles the performance measures in its 2020 Statewide Transit Plan update. MARTA's continued transition to a zero-emission bus fleet will help the State of Georgia meet the White House goal of a 50% reduction from 2005 levels by 2030.

Support for Local Policy Goals

On May 1, 2017, the Atlanta City Council adopted 17-R-3510, which adopted a goal of 100% clean energy by 2035. MARTA will be helping the City of Atlanta meet this goal with the transition of the bus fleet to zero-emissions.

Element 4: Facilities Assessment

Facilities Assessment Projects

The following section introduces the timeline and cost estimates for the infrastructure associated with MARTA's transition to zero-emission buses.

MARTA's Current Facilities

MARTA currently operates its fleet of transit and mobility buses out of four depots: Laredo Drive, Perry Blvd., Hamilton Blvd., and Brady Ave. These facilities are equipped to maintain and fuel diesel, CNG, and gasoline buses. MARTA's 2019 Low/No project is installing the first six 150 kW depot chargers at the Laredo depot.

MARTA's Clayton Operations & Maintenance Facility will replace Hamilton Garage when it opens in 2026. Therefore, MARTA is not including that facility in this analysis.

MARTA also has 38 heavy rail stations, each with its own power substation to support the facility. MARTA is installing its first overhead pantograph charger at its Edgewood-Candler Park Station in 2023 to support on-route charging for its 2019 Low/No bus blocks.

Battery Electric Bus Facilities Assessment Overview

Scaling to a fleetwide battery electric bus deployment requires substantial infrastructure upgrades and a significantly different approach to charging compared to smaller deployments. With initial deployments, charging requirements are met relatively easily with a limited number of plug-in pedestal chargers and minimal infrastructure investment.

Full fleet deployments of battery electric buses, however, require installation of a significant number of charging stations and improvements to existing electrical infrastructure. These improvements may include upgrades to switchgear or service connections. Planning and design work, including development of detailed electrical and construction drawings required for permitting, is also necessary once specific charging equipment has been selected.

To determine the installation timeline and costs for charging equipment, this assessment breaks the infrastructure scope of work into three key project types: planning, power upgrades, and charging equipment (charger and dispensers) installation. Estimated costs associated with each project type are included in **Table 4**.

Table 4 – Battery Electric Bus Infrastructure Project Cost Assumptions

Project	Estimate Metrics	Cost Estimate	Source
Infrastructure Planning	Infrastructure Design and Planning	$200k per project	Engineer's estimate
Power Upgrade Projects	Design, Construction, & Equipment	Variable ($200k-$400k) per project dependent on capacity added	Engineer's estimate, includes 20% contingency
Charging Installation Projects	Charging Equipment & Installation	$125.5k per 150 kW charger $12k per dispenser	Quotes and estimates, includes 20% contingency

Key assumptions applied in the agency's Facilities Assessment are as follows:

- One plug-in dispenser per bus;
- Two buses per 150 kW charger;
- Two charge windows, i.e., no more than half the buses charge at any given moment;
- Incremental power requirements are met over time. Power upgrades are consolidated to occur in selected years, in accordance with the required demand; and
- Dispenser capacity to serve up to 80% of the fleet at a time; no movement of buses overnight.

Battery Electric Bus Infrastructure Cost Summary

Figure 4 summarizes all costs for charging infrastructure for MARTA's transition to a battery electric bus fleet. The estimated total infrastructure costs are approximately $65.5 million at the three depots combined. This total cost includes power upgrade projects, charger and dispenser installations, planning projects, design-engineering costs, and a 20% contingency on all costs.

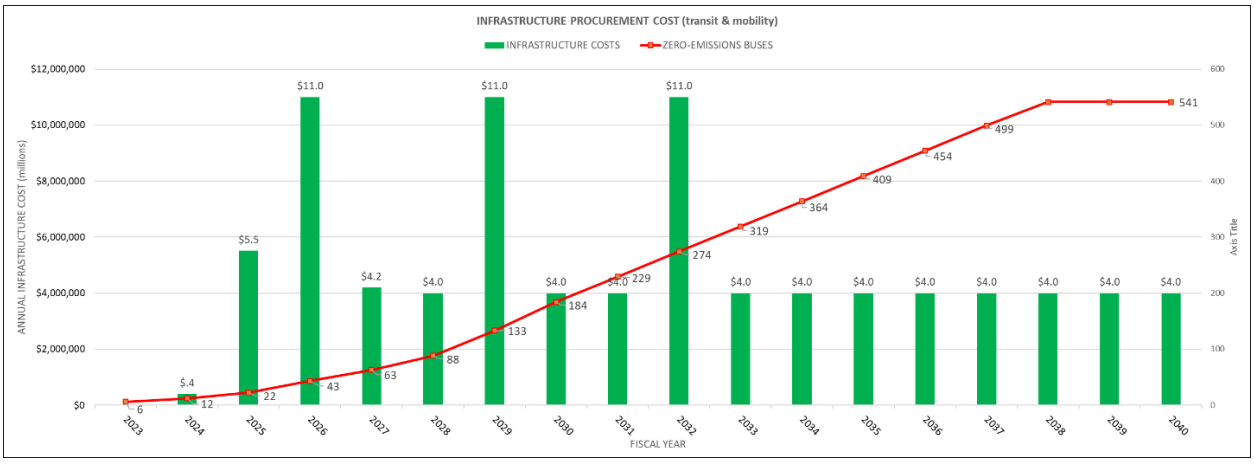

Figure 10 - Depot Only Annual Costs, Infrastructure – Transit & Mobility

Element 5: Partnership Assessment

Battery Electric Bus Partnership

As an operator of heavy rail service, MARTA has a longstanding relationship with its electrical utility, Georgia Power, as a transportation fuel supplier, and the utility fully supports this application (see letter of support in Attachment J). Georgia Power is also a partner on MARTA's 2019 Low/No program deployment of six BEBs, and the two organizations are continuing to collaborate on planning of future facility and fleet needs. MARTA leverages a time of use rate for its depot charging at facilities, meaning it can charge in off-peak overnight periods for as little as $.02/kWh (before fees and riders). For its on-route charging at Edgewood-Candler Park Station, MARTA uses Georgia Power's Medium Power and Light rate schedule. As this option carries a higher per kWh cost and incurs demand charges, MARTA is planning future routes to minimize on-route charging needs.

Georgia Power currently offers a $6 million/year make-ready program to support the deployment of electric vehicle charging infrastructure across the state. This funding has supported other public sector fleets across the state, and MARTA expects to leverage this program in the future to support facility upgrades.

MARTA is aware that taking advantage of these benefits and ensuring a successful BEB deployment requires close, ongoing coordination with Georgia Power. MARTA's discussion of short- and long-term fleet goals with Georgia Power ensures that Georgia Power can properly plan grid-side electrical infrastructure upgrades and that MARTA can adequately upgrade behind-the-meter equipment to support battery electric buses. Once the infrastructure upgrade needs are established, MARTA will incorporate the design and construction timelines into the overall transition plan timeline.

MARTA recognizes Georgia Power as a critical partner in electrification and will continue to partner with Georgia Power after the planning stages, so that charge management strategies and fleet expansion efforts can be coordinated effectively.

Element 6: Workforce Analysis

MARTA, located in metro Atlanta, GA operates a fleet of 517 transit buses and 240 mobility buses, including six transit BEBs. The agency is a leader in the Southeast in transitioning to ZEBs and plans to fully transition its fleet to zero-emission technologies by 2040. MARTA deployed its first six BEBs in 2022 and has secured Congressionally directed spending to procure additional vehicles. If awarded, the 2023 Low/No proposal will add 35 mobility BEBs to the fleet in 2025. In order to support ZEB operations at this scale, MARTA has identified opportunities to ensure the current and future workforce is prepared to manage its transitioned fleet of 535 transit and 275 mobility BEBs. This Workforce Development Plan focuses on transit ZEB operations and maintenance. MARTA's current and future mobility Contractor(s) will be required to develop a training program with MARTA oversight in order to maintain mobility ZEB's.

In alignment with FTA's requirements under the Workforce Development for the 2023 Low/No program, MARTA will build a ZEB workforce training program in consultation with labor representatives and will continue to build on a current apprenticeship program already in place and determine how to best reskill and upskill the current workforce to meet the needs of MARTA's future operational and maintenance needs. MARTA's mobility Contractor will develop similar training requirements with MARTA oversight.

Workforce Analysis Overview

Developing and training the workforce required to operate and maintain zero-emission buses requires significant investment and planning. MARTA is experienced in recruiting, hiring, training, and integrating new staff to ensure that employees are qualified to provide quality services to our riders. The level of training that MARTA staff engage in upon hiring is dependent upon their level of experience at that time. MARTA recognizes that a trained ZEB workforce is not readily available, and the transit industry must address the shortage of technicians and mechanics together.

MARTA plans to develop and maintain a qualified ZEB staff by hiring qualified new staff and retraining existing staff who have previously worked with internal combustion engine (ICE) systems. Meaningful investment is required to upskill maintenance staff and bus operators that were originally trained in diesel and CNG vehicle maintenance and fossil fuel fueling infrastructure. Transitioning to zero-emission vehicles is a paradigm shift for all aspects of transit operations including but not limited to scheduling, maintenance, and yard operations. MARTA's workforce development activities will address the identified skills and tools needed for each relevant team.

MARTA's represented workforce is the Amalgamated Transit Union Local 732, which supports this grant application and provides input on MARTA's workforce development activities (see Attachment J). MARTA's Technical Training Team has previously worked on the development of future Apprenticeship Programs in the areas of Track Repair and Advanced Electronics with ATU's local leadership team and ATU's International Apprenticeship Team, also in collaboration with Transportation Learning Center and Department of Labor's representative for Georgia Apprenticeships. Therefore, MARTA's training plan will be reviewed by ATU 732 for the transition of the workforce from more traditional fuel engines to future technology ZEB propulsion.

For the first six BEBs, MARTA utilized New Flyer's training support, elements of which include general understanding of how electricity moves throughout the bus, troubleshooting on the bus and education of local fire departments on how to address BEB Emergencies. MARTA has planned maintenance materials to support the current New Flyer Fleet which will support more detailed systems training materials development, which again could be used to support the transition of its incumbent workforce into ZEB technologies.

With additional support, MARTA will further develop an in-house introductory training program. A portion of the training will be designed to transition members of its workforce from diesel/CNG technologies fleet to ZEB fleet with a focus on base knowledge on electrical systems and their maintenance, repair and troubleshooting.

MARTA will also work closely with our mobility Contractor to ensure a sufficient level of training for all technicians.

MARTA's existing Apprentice Program identifies internal workforce candidates who enter the program upon successful completion of an aptitude test. The 2-year Apprenticeship Program goes through fundamentals of transit bus repair and maintenance and then moves to specific MARTA models.

MARTA has relationships with Georgia Piedmont Technical College (GPTC), Atlanta Technical College (ATC), and Gwinnett Technical College (GTC). Gwinnett Technical College has a jointly developed Rapid Transit Technology Diploma Program, certified by the state, designed to support GTC students seeking careers in Transit Technologies; e.g. Railcar ET, High Voltage Power Tech, or Train Control Tech. Collaborations with the local Technical Colleges will be key to MARTA's short and long-term futures.

The major challenge MARTA is experiencing in the area of technicians is lack of 2-year vocational degree graduates applying for employment at the Authority. Increasing MARTA's foothold in the ZEB arena, and further developing the associated, highly technical training will allow MARTA to better position its recruitment of Advanced Technologies graduates into our workforce by presenting them with cutting edge, future technologies equipment to work on. This will support our current equipment readiness needs and will help to address our future as these more technically competent employees matriculate their way up into leadership positions.

Currently MARTA has Technical Training employees serving on the advisory committees for Atlanta Technical College's Diesel and Automotive Programs, and Gwinnett Technical College's Advanced Electronic Program. Every step MARTA is able to take towards higher technology platforms assists MARTA in recruiting technologically more sophisticated workforce, which again benefits MARTA, and the transit industry proper, both now and in the future.

Completed Trainings

In support of the six newly acquired New Flyer Electric Buses MARTA has preliminarily provided the following training, largely to its Frontline Management and Instructor workforce (unless otherwise indicated).

- MARTA eBus Operator Training – 149 Bus Operators
- New Flyer eBus Instructor / Technician Training – 7 employees attended
- New Flyer eBus High Voltage Training & Diagnostics – 5 employees attended
- New Flyer eBus HV Safety, Instructor 2021 – 6 Instructors attended
- New Flyer eBus HV Safety Class – 7 employees attended
- New Flyer eBus Emergency Response Training – 283 Local Firefighters & MARTA Safety Employees

In the future, MARTA looks to develop greater skills proficiency in its Bus Technician's workforce with regards to their ability to understand and troubleshoot network electronics, and with regards to their ability to understand and troubleshoot eBus High Voltage Propulsion Systems.

As it relates to MARTA readiness to maintain ZEB High Voltage equipment:

- MARTA is in possession of their current New Flyer eBus' Maintenance procedures which do outline safety precautions and their associated procedures for mitigating hazards prior to performing work.

- MARTA's Technical Training Manager has more than 35 years of experience working on, or overseeing work or training on High Voltage equipment, to include US Navy Weapons Radar Equipment, Transit 750 VDC Train Propulsion Equipment and the oversight of HV Traction Power Training at both WMATA & MARTA. Additionally, our Manager's history includes the authoring of LA Metro's Planned Maintenance Inspection Requirements & Schedules for the Nippon Sharyo and Siemens Fleets at one time, and the co-chairing of the committee that completely re-wrote the Inspections Requirements and Schedules for the six (at that time) WMATA Railcar Fleets. He also has served as Vice-chair of APTA's Vehicle Inspection and Maintenance Committee.
- High Voltage Training has been provided to MARTA's Instructional Staff on the current ZEB fleet.

MARTA currently trains Bus Maintenance Candidates on the following subjects which are cross-applicable to ZEBs:

- Networks – fundamentals and troubleshooting of Coach Networks
- Friction Brake – during blended and after regenerative braking friction brake elements are applicable
- HVAC
- General & Mechanical Maintenance Practices

Obviously MARTA's Bus Maintenance Training is under expansion so that the new challenges of our six ZEBs can be fully supported post warranty. This expansion will include a greater emphasis on Electronics, Electrical Safety practices and ZEB Electronic/Electrical Propulsion systems, their maintenance and repair. Success in this endeavor will revolve around providing service that meets internal and external needs for reliability. Existing fleets have service related KPIs which will certainly be translated to ZEB fleets and support group performance.

Identified Training Needs

Several training needs have been identified by MARTA staff in order to support their transition to a 100% ZEB fleet. MARTA is committed to ensuring new training and technologies do not displace current workers and has placed a priority on training existing staff as well as developing an apprenticeship program. The identified training needs are anticipated to evolve as MARTA's fleet expands. As such, the following training plans are intended to provide a framework.

1) *Apprenticeship Program*
   MARTA currently has a two-year Bus Maintenance Apprenticeship Program that is Department of Labor Certified and which has been in existence for more than a decade. Additionally, MARTA has a six-month Journey-level Training Program for Bus Technicians that has been in place for more than six years.
2) *Train-the-trainer approach*
   Many procurement contracts include train-the-trainer courses through which small numbers of agency staff are trained and subsequently train agency colleagues. This method provides a cost-efficient opportunity to minimize the need for external training while onboarding institutional knowledge and supporting initial agency training on new equipment and technologies. MARTA currently relies on OEM training for their newly

acquired ZEB fleet but is using a train-the-trainer approach to facilitate the acquisition of knowledge until the ZEB program can be brought in house like all other elements of the Bus Maintenance Training Program. Third party resources will continue to be used as needed until the transition can be facilitated.

3) *Vendor training from bus and charger vendors*
MARTA plans to take advantage of trainings from the bus manufacturers and infrastructure suppliers, including maintenance and operations training, maintenance and safety, first responder training, and other trainings that may be offered by the providers. OEM trainings provide critical information on operations and maintenance aspects specific to the equipment model procured. MARTA training staff will work closely with the OEMs providing vehicles to ensure all mechanics, service employees, and bus operators complete necessary training prior to deploying ZEB technology. MARTA staff will also be able to bring up any issues or questions they may have about their training with their trainers. Additionally, trainers will observe classes periodically to determine if any staff would benefit from further training.

4) ZEB tools
The following tools have been identified as top needs to bring in-house as more of the maintenance and management falls to internal staff with an expanded ZEB fleet.
   - Mock-ups of all significant ZEB systems should be provided to support both the training and development of training that can be provided in locations which do not have direct access to vehicles, or the ability to support vehicles.

5) Retraining/refresher training courses
Access to OEM training resources would be highly desirable. Refresher and follow-on training could be subsequently developed. Access to, or the support of a curriculum developer with an understanding of electronics for one year would be highly desirable. An asset like this could be used to fully develop the entire training program using OEM source materials.

6) ZEB Training from other transit agencies
MARTA would be interested in using any available manuals or training created at sister transit agencies, so long as the content was determined to be directly applicable to the ZEB equipment utilized by MARTA, and, as much as is possible given certain proprietary claims and copyrights, MARTA would reciprocate in the willingness to share MARTA materials with the Transit Community broadly.

7) National Transit Institute training
MARTA has previously utilized NTI training and materials and would be highly receptive to doing so ZEB fleet. It intends to leverage funding under the 2022 LowNo program to support sending MARTA staff through multiple NTI courses.

8) *Local Partnerships and Collaborations*
As previously described, MARTA has partnered with local Community Colleges in many ways that are directly applicable to the ZEB fleet. MARTA has partnered with Gwinnett Technical College to create a Transit Technician Diploma Program. MARTA employees serve on the advisory committees for both Atlanta Technical College and Gwinnett Technical College. A draft Advanced Electronics Apprenticeship Program contains curriculum sourced both from courses available local Community Colleges and from internal MARTA offerings. MARTA currently outsources CDL training to Georgia

Piedmont College. MARTA's integration with local educational institutions is broad and, in many cases, deep.

Resources and Strategies to Meet Identified Needs

In order to incorporate the above training needs, MARTA envisions using following resources and strategies. To achieve these goals and ensure a successful deployment of zero-emission buses, MARTA will require external funding to cover the workforce development initiatives identified. FY2023 Low/No funding will ensure the workforce development plan can be implemented in parallel with deployment of vehicles and infrastructure. The workforce development strategies detailed above are encompassed in the budget items requested below, however, this funding request is only a small percentage of what would ultimately be needed to transition the entire fleet.

Table 8: Training Resources

Training Resource/Strategy	FY2023 Low-No Budget
OEM Training for Instructors, Operators, Maintenance Staff, and First Responders	$700,000
Infrastructure Training	$250,000
Training Aids, Simulators, Components, Equipment	$300,000
NTI Trainings	$10,000
Total	$1,335,000

Workforce Development Timeline

Demand for skilled and experienced workers will increase rapidly as new clean transportation policies and programs take effect and as numerous agencies begin fleet transitions. Aligning workforce development activities with the fleet transition timeline ensures that a qualified workforce is ready and available to support a successful deployment. Based on MARTA's fleet transition plan of becoming 100% zero-emission by 2040, the graphic below shows the anticipated progression. By 2026, MARTA will have a battery electric fleet of 37 buses, which is 6% of the total fleet. By 2030, MARTA will have a battery electric fleet of 184 buses, which is 34% of the total fleet. By 2035, MARTA will have a battery electric fleet of 409 buses, which is 76% of the total fleet, and all diesel buses would be retired. By 2040, MARTA will have a battery electric fleet of 535 buses and be 100% zero-emission.

Currently all Operators and Extra-board Operators on all lines that are utilizing ZEBs are fully trained.

MARTA's future plan would be to implement Operator Training as needed such that the ZEB skills would be immediately put into use and thusly retaining would not be required.

Mechanical Training would be implemented in multiple stages to include:

- Prior to Warranty Stage - 30% of applicable Bus Workforce would be trained in the maintenance and repair of the ZEBs such that they could intelligently shadow Warranty Labor so as to be prepared for the day when the Warranty expires.
- Post Warranty Stage – remainder of applicable workforce would be methodically trained.

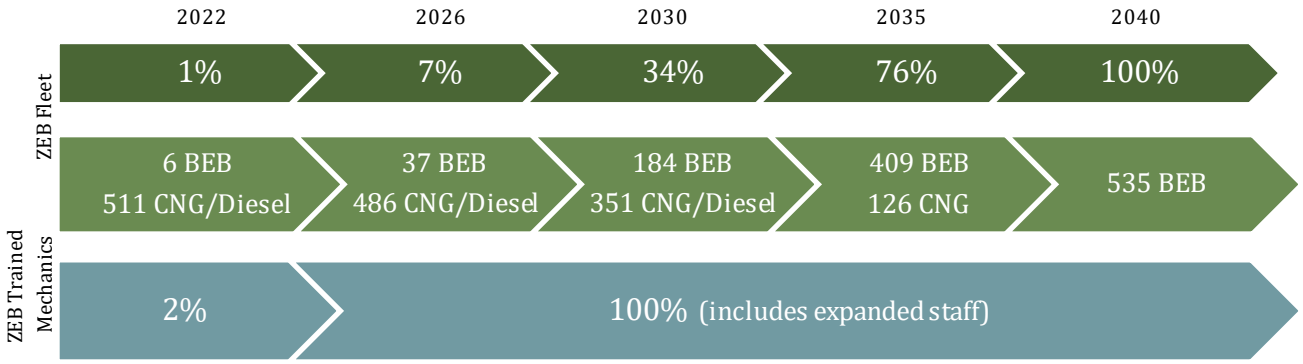

Figure 2: ZEB Fleet & Mechanic Transition Plan

Workforce development is an ongoing process that must continue as fleets scale up and deploy additional zero-emission vehicles. To ensure that the workforce scales efficiently and cost-effectively, MARTA will employ training strategies that support additional zero-emission vehicle deployments in the future. MARTA anticipates that its needs will shift over time as it looks to new vehicle and fueling technologies, and its workforce development programming will evolve accordingly.