Stateline Mass Transit District

Zero Emission Bus Transition Plan

November 2023

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Acronyms and Abbreviations

AC	alternating current
BEB	battery electric bus
DC	direct current
EPA	United States Environmental Protection Agency
FCEB	fuel-cell electric bus
federal	Federal Government
FHWA	Federal Highway Administration
ft	foot/feet
FTA	Federal Transit Administration
GHG	greenhouse gas
GILLIG	Gillig Transit Bus Manufacturing
IIJA	Infrastructure Investment and Jobs Act
kW	kilowatt(s)
kWh	kilowatt-hour(s)
mi	mile(s)
OEM	original equipment manufacturer
Plan	Zero-Emission Transition Plan
RAISE	Rebuilding American Infrastructure with Sustainability and Equity
RMTD	Rockford Mass Transit District
SMTD	Stateline Mass Transit District
SOC	state of charge
USDOT	United States Department of Transportation
ZEB	zero-emission bus
ZEBRA	Zero Emission Bus Resource Alliance

Executive Summary

The transportation sector is a significant driver of greenhouse gas (GHG) emissions in Illinois. Public transit plays an important role in reducing GHG pollution by reducing vehicle-miles traveled by the general population. Transitioning the vehicle fleet of transit agencies to electric vehicles further reduces emissions, improving local air quality and public health. The Zero-Emission Transition Plan (the Plan) is the Stateline Mass Transit District's (SMTD) roadmap to help guide the agency toward a more environmentally conscious operation.

The Plan begins with an overview ("Transition Plan Context and Purpose"), which identifies relevant policies, initiatives, and studies. The overview also discusses the various technologies and associated considerations for each vehicle type. These technologies are discussed more detail in the "Zero Emission Technology Overview" section, which describes various zero emission technology types and battery and charging infrastructure.

The evaluation of existing vehicles and their relationship to the technology transition is discussed in the "Electrification Analysis & Evaluation" section. Descriptions of the service & fleet analysis, including the current fleet composition, and a facility analysis are provided in this section.

The Rockford Mass Transit District (RMTD) provides drivers, maintenance, storage, administration, and related services for SMTD through an intergovernmental agreement. Success in transitioning to zero emission vehicles depends on the preparation of the facilities, the charging infrastructure, and the workforce for this new technology. Although the SMTD may elect to pursue other opportunities to operate its service in the future, this transition plan reflects the service as it exists today, which depends on RMTD's goals aligning with those of SMTD. RMTD is also committed to transitioning its own operation to a zero-emission fleet and will work with SMTD to make the necessary infrastructure and workforce development changes necessary to support SMTD's transition. As such, elements of the SMTD plan will mirror RMTD's Federal Transit Administration (FTA)-compliant Zero-Emission Fleet Transition Plan. A copy of this plan is provided for reference as Appendix A.

This report also identifies the next steps for SMTD in its transition to a zero-emission fleet.

The plan's responsiveness to the six elements required of a FTA-compliant Zero Emission Fleet Transition Plan can be found on the following headings and pages:

- Demonstrate a long-term fleet management plan: "Fleet Transition Projection" (page 11)
- Availability of current and future resources to meet costs for the transition and implementation: "Funding Availability" (page 14)
- Policy and legislation impacting relevant technologies: "Existing Policies, Initiatives, and Studies" (page 3)
- Evaluation of existing and future facilities: "Facility Analysis" (page 11)
- Partnership of the applicant with the utility or alternative fuel provider: "Utility Coordination" (page 14)
- Impact of the transition on the applicant's current workforce: "Workforce Development & Training" (page 15)

Transition Plan Context and Purpose

Reducing transportation-related emissions not only helps improve local air quality but also helps reduce GHG pollution, which contributes to negative global impacts. SMTD is committed to reducing the environmental impacts of its transit operations by evaluating low- and no-emission vehicles and implementing a zero-emission transition plan.

Stateline Mass Transit District Service and Vehicles

SMTD provides demand-response bus service to all residents that live within its service area, which consists of the northern Illinois communities of the City of South Beloit, the Village of Rockton, the Village of Roscoe, Rockton Township, and Roscoe Township (**Figure 1**). SMTD service is not limited to medical trips, but qualifying medical trips are made to and from medical facilities outside the normal SMTD service area.

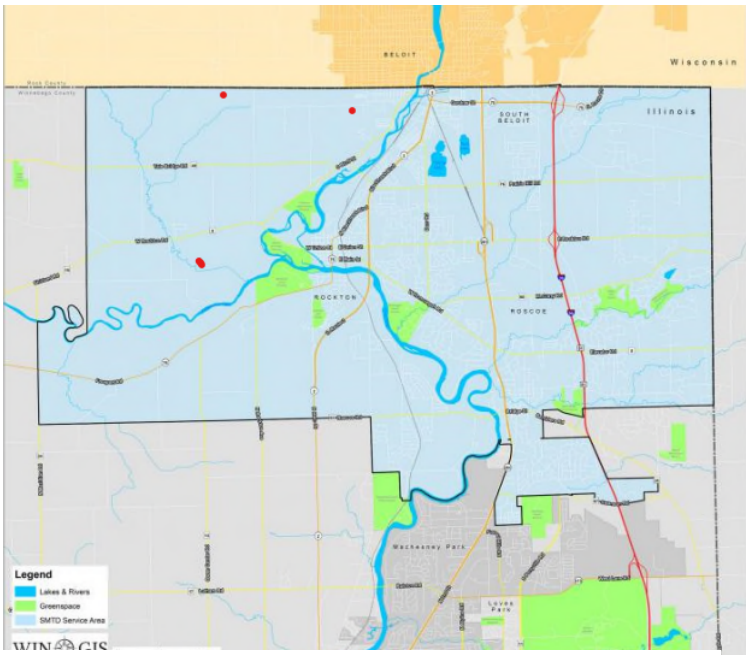

Figure 1: SMTD Service Area

SMTD currently operates eight cutaway-style demand-response vehicles and plans to add three additional vehicles. It does not own any operating facilities and RMTD provides drivers, maintenance, storage, administration, and related services for SMTD's daily operations through an intergovernmental agreement.

Environmental Impacts of Transit

Transit has an important role to play in reducing a region's overall GHG emissions. Any time passengers choose to ride transit rather than drive their own vehicle, overall vehicle mileage traveled is reduced, along with net emissions. These net benefits can be further improved by reducing the emissions from transit vehicle operations.

Trend Toward Zero-Emission Buses

Both nationally and internationally, transit agencies are implementing strategies to reduce emissions from their fleets by integrating more low- and no-emission technologies. Zero-emission bus (ZEB) adoption in the United States is anticipated to accelerate due to increased funding availability to support ZEB purchases and increased adoption of emissions-reducing policies by local governments and municipalities. As of September 2022, 5,480 ZEBs are on the road, awarded, or on order in the United States and Canada, which is a 66 percent increase since 2021.[1] The West Coast (California, Oregon, and Washington) account for 41 percent of all ZEBs

[1] CALSTART, *Zeroing in on ZEBs: The Advanced Technology Transit Bus Index: A ZEB Inventory Report for the United States and Canada* (February 2023).

nationwide. However nearly every state (exceptions are West Virginia and the Dakotas) has at least one ZEB on the road or on order to date; including Illinois, which has 137.

Existing Policies, Initiatives, and Studies

Nationally and locally, reducing emissions is of increasing concern, as scientific research continues to demonstrate the wide range of environmental and health benefits that result from reduced emissions. This section identifies policy and legislation with implications for SMTD's transition to ZEBs.

Infrastructure Investment and Jobs Act

Signed into law by President Biden on November 15, 2021, the Infrastructure Investment and Jobs Act (IIJA), also known as the "Bipartisan Infrastructure Law," invests "$89.9 billion in guaranteed funding for public transit over the next five years—the largest Federal investment in public transit history."[2] As part of these transit investments, the IIJA includes provisions to support and increase investment in zero-emission vehicles through grant programs, studies, fleet funding, and other measures.[3] In particular, the IIJA includes provisions to continue the grants for the Buses and Bus Facilities program with increased funding levels compared to that of previous authorizations. The IIJA also includes funding appropriation for the Low-No Grant program at around $1.1 billion annually from 2022 through 2026 (the Low-No Grant program is a program in the FTA's Buses and Bus Facilities program). This discretionary grant program requires agencies to have a zero-emission fleet transition plan. It also requires that 5 percent of Low-No Grants related to zero-emission vehicles and related infrastructure be used for workforce development activities, unless the applicant certifies that less is needed to carry out their zero-emission fleet transition plan. However, It should be noted that Federal Government (federal) transit funding focuses on capital needs, not the costs associated with the operation and maintenance of ZEBs or other transit services.[4]

Illinois Policies & Goals

In 2019, Illinois entered into the U.S. Climate Alliance and committed to the following actions:

- Implement policies that advance the goals of the Paris Agreement, which aim to reduce GHG emissions by at least 26 to 28 percent below 2005 levels by 2025.
- Track and report progress to the global community in appropriate settings, including when the world convenes to take stock of the Paris Agreement.
- Accelerate new and existing policies to reduce carbon pollution and promote clean energy deployment at the state and Federal level.

Based on SMTD's history of operations and encouragement from state policymakers, there are no state policies or legislation that should hinder the implementation of this plan.

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[2] The White House, *Fact Sheet: The Bipartisan Infrastructure Deal* (November 6, 2021).
[3] Alternative Fuels Data Center, *Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act of 2021)* (N*ovember 15,* 2021).
[4] Federal Transit Administration, *Fact Sheet: Buses and Bus Facilities Program* (last updated December 9, 2021).

Zero Emission Bus Technology Overview

Currently, three ZEB technologies are commercially available: electric trolleybuses, fuel-cell electric buses (FCEBs), and battery electric buses (BEBs).

Although electric trolleybuses have been in use for nearly a century, only five transit agencies across the country currently operate this type of ZEB as a part of their regular service offerings.[5] Power to these buses is provided via two trolley poles connecting the top rear of the bus to overhead catenary wires. This technology is not available to demand-response vehicles.

FCEBs—buses that use an onboard electrochemical hydrogen fuel cell for propulsion—are growing in prevalence across the U.S., with adoption of these buses increasing by 64 percent since 2021.[6] There are currently two agencies in the U.S. piloting demand-response vehicles with fuel cell electric propulsion, but these vehicles are not in commercial production and are still an unproven technology. As such, the SMTD is not currently considering this technology.

BEBs use onboard battery packs for bus propulsion and power rather than conventional fuels such as diesel or gasoline. When BEB acceptance in the United States is discussed, the figures presented typically reflect full-size transit buses that are over 30 feet in length. The SMTD operates small transit buses (defined as under 30 feet). Such buses make up a significant portion of transit vehicles in the country. The transition to BEB technology for these smaller vehicles has not been as prevalent as with full-size buses, but this transition is increasing for small buses. There was a 111 percent growth in the deployment smaller public transit vehicles from 2021 to 2022, and there was great adoption of these vehicles in private-sector industries. As such, BEB technology is the most advantageous for SMTD to use as it implements its zero-emission transition plan.

BEB Vehicle Considerations

The batteries onboard a BEB are used to provide both the energy required to drive the bus and the energy necessary to operate all vehicle auxiliary functions, including the heating and cooling of the passenger cabin. The amount of energy provided by the battery is described by its energy capacity measured in kilowatt-hours (kWh). Unlike conventional buses, which typically have enough diesel or gasoline to power the vehicle for an entire day, BEBs typically have a reliable range in transit service of 100 miles or less on a single charge.[7] A BEBs range is a function of two primary characteristics: (1) battery capacity and (2) energy usage.

Larger **battery capacity** translates to increased energy (fuel) storage and thus increased range. Smaller transit buses are limited in their battery capacities, as the size and strength of the vehicle limits its ability to carry heavy batteries. In addition, just as operators avoid driving a conventional bus until the fuel tank is empty, a portion of a BEB's battery capacity is typically preserved for operational flexibility. By preserving this capacity, transit agencies are able to ensure that BEBs will have sufficient range to return to the garage in the event of an unforeseen delay or other unexpected event requiring a BEB to remain in service longer than originally planned.

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[5] Federal Transit Administration, *The National Transit Database (NTD)* (last updated November 2, 2022).
[6] CALSTART, *Zeroing in on ZEBs: The Advanced Technology Transit Bus Index: A ZEB Inventory Report for the United States and Canada* (February 2023).
[7] National Academies of Sciences, Engineering, and Medicine, *Guidebook for Deploying Zero-Emission Transit Buses* (Washington, DC: National Academies Press. https://doi.org/10.17226/25842.2021, 1921).

The amount of **energy usage** by the bus (kWh/mile) also impacts BEB range. When the energy used to heat and cool the bus cabin is the same energy that would be used for the propulsion of the bus, bus range can be substantially reduced in cold or hot weather, as increased energy must be devoted to maintaining a comfortable temperature in the passenger cabin. The speed at which a BEB operates also influences energy usage and therefore BEB range. Typically, slower speeds are a result of either busy or congested environments. In busy environments, buses often see greater energy usage, owing to bus doors being open more often and for longer periods of time. When the doors are open, the heating and cooling of the bus cabin is more difficult, as extra energy needs to be drawn from the battery. Also, when buses are stuck in congested environments, they spend an increased time idling and accelerating from rest, thereby also requiring greater energy usage. Efficient operation of the vehicle through gentle accelerations and decelerations can reduce energy usage by not only requiring less energy to accelerate from rest, but also maximizing the ability of the bus to regenerate energy. When the bus is rolling forward, BEBs are capable of recapturing some of that energy and improving their overall energy usage. From this combination of factors, energy usage on the same bus can vary widely within a single transit agency's operation and therefore lead to different functional ranges.

Charging Infrastructure

In the North American BEB industry there are currently three primary types of BEB chargers: (1) plug-in chargers, (2) overhead conductive chargers with inverted overhead pantograph dispensers, and (3) in-ground wireless inductive chargers (**Figure 2**). Plug-in chargers are typically used at garages and in bus service/maintenance bays, whereas overhead and inductive chargers can be used for either garage or on-route (opportunity) charging. BEB charging infrastructure typically includes transformers, switchgear, chargers (charger "bases/cabinets," where the majority of charging equipment is housed, including alternating current (AC)–direct current (DC) rectifiers, charge controls, and communication), and dispensers (e.g., pantographs or plugs).

Plug-In

Source: Lightning eMotors

Overhead Conductive

Source: TriMet, March 2021

Wireless Inductive

Source: Link Transit & eVehicle Technology

Figure 2: BEB Charging Infrastructure

Plug-in chargers can be either an all-in-one unit with dispensing plug-in cords attached directly to the charger cabinet or a charging cabinet connected to remote plug-in dispensers **(Figure 3**).

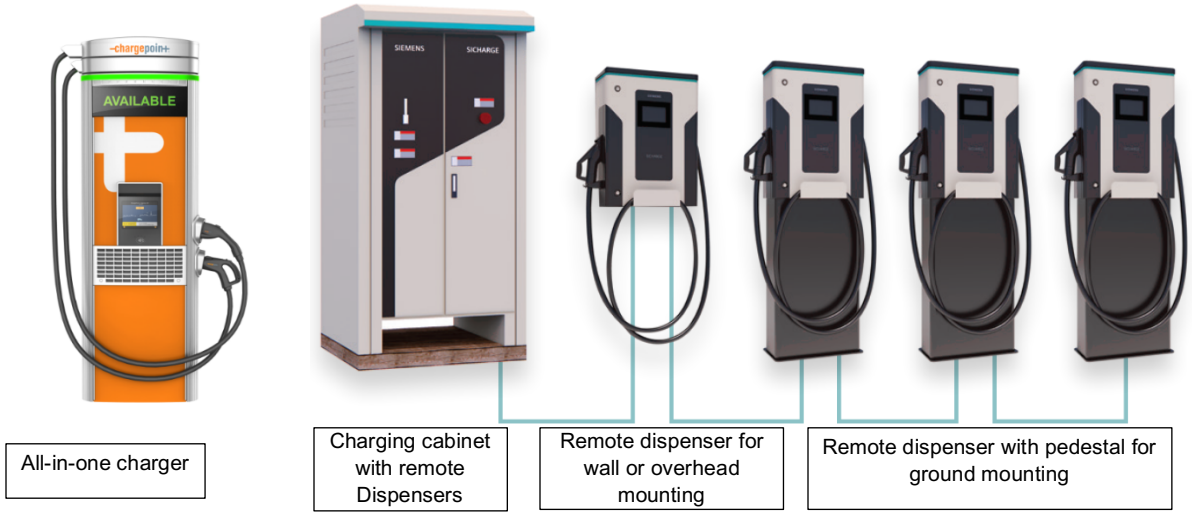

Figure 3: Plug-In Charger Detail

The smaller size of a remote dispenser allows for multiple vehicles to be charged away from the large charging cabinet which is practical when powering multiple larger vehicles. Typically, an all-in-one charger has one or two cords while a charging cabinet can energize between one to four remote dispensers, allowing for scheduled charging of multiple buses. Charge power for plug-in chargers ranges from 8 to 80 kilowatts (kW) for small transit buses. There is specialized equipment that is able to charge these vehicles at 220 kW or higher, but it is expensive. Due to the relatively low power of typical equipment, plug-in chargers typically take several hours to fully charge a bus and are therefore often used for overnight charging. A factor to be considered with shared charging (one charging cabinet energizing multiple dispensers) is that, depending on the charger manufacturer and model, the name plate rating of the charger (120 kW, for example) might only output a maximum of 60 kW if the one charger cabinet is energizing two dispensers (expressed as a 1:2 charging ratio). There is no industry standard yet for a shared charging configuration, so any shared plug-in charging assumed-performance operations (e.g., ability to provide 80 kW to any dispenser at a time) is recommended to balance the planned incoming charging equipment with the anticipated charging operational time. BEBs by default have charging ports that are in similar locations as conventional internal combustion engine fuel ports (e.g., curb side, rear quarter of bus). Buses can be specified to have plug-in ports on a specific area of the vehicle, but most plug in locations are manufacturer determined. Per unit capital costs for plug-in chargers are lower than for other types of charging infrastructure. The J1772 standard, published by the Society of Automotive Engineers, allows for interoperability of plug-in chargers with different types of buses from multiple manufacturers, analogous to the standardized pump size for gasoline vehicles across manufacturers, which allows you to fill your gas tank at any gas station. Retrofitting ground-mounted charger cabinets (2 feet [ft] to 3 ft 6 inches) in depth adjacent to parked buses in existing, dense bus parking arrangements can lead to blocking of staff circulation or create a bus-to-charger impact danger. On large retrofit deployments at existing

dense, closely parked depots, it is not uncommon to have to eliminate some bus parking spaces to allow for ground-mounted chargers. Overhead suspended dispenser plug-in cords mounted over parked buses energized by charging cabinets located remotely away from bus parking can be used where ground-mounted plug-in cord equipment is impractical or not desired. Overhead plug-in cords over buses, if not left always dangling protected by bollards or other structures, would require some means to retract and extend the cords. Currently, the original equipment manufacturers (OEMs) do not offer a remote overhead reel or retraction system and rely on third-party vendors or site-specific custom solutions that range from the simple, suspended rope tagline connected to a manual pull charging cord to powered retraction systems that use reels or winches.

Overhead conductive chargers typically use an extending arm pantograph or piston-mounted charging bars that lower down from the charger to connect to the roof-mounted charge rails on the bus. This technology does not currently exist for demand-response vehicles.

Inductive chargers use a wireless power pad as the charging dispenser embedded in the floor of a garage or roadway surface in conjunction with a power receiver installed under the bus. This technology is relatively new with full-size BEBs, and it is gaining popularity as the technology matures. Currently, inductive charging is not being used to charge small transit BEBs; however, companies are beginning to provide trial inductive charging options for battery electric cars and small fleet vehicles, and these options may also benefit smaller BEBs.

Electrification Analysis & Evaluation

Service & Fleet Analysis

This section analyzes SMTD's demand-response fleet and its services to identify if its vehicles are viable for a one-to-one transition to BEBs with only garage charging. This analysis looks at three scenarios: current technology BEBs, BEBs with moderate technology improvement, and BEBs with significant technology improvement.

Current Fleet Composition

As noted above, SMTD's fleet currently consists of eight cutaway-style, medium-duty vehicles. Six of these vehicles are 14-passenger, gasoline-powered vehicles, and the remaining two are 26-passenger, super-medium-duty diesel-powered vehicles. The agency is scheduled to receive three expansion and has applied for six replacement 14-passenger, gasoline-powered cutaways which have yet to be awarded.

Service Analysis Assumptions

SMTD currently operates service Monday through Friday from 5:15 a.m. to 10:00 p.m., Saturdays from 6:00 a.m. to 6:00 p.m., and Sundays from 8:15 a.m. to 4:30 p.m., with no service on six major holidays throughout the year.

As discussed above (see "BEB Vehicle Considerations"), battery/energy capacity and energy usage are the primary drivers influencing EV range and consequently the viability of EVs to meet existing service requirements. The following section defines the assumptions for each factor used to assess the viability of EV service. The battery capacity and energy usage assumptions are summarized in **Table 1**.

Table 1: Assumptions for Demand-Response EV Service Analysis for Three Scenarios

Factor	Current Technology	Moderate Technology Improvement	Significant Technology Improvement
Battery size (nominal capacity)	122 kWh	153 kWh	191 kWh
Battery size (usable capacity)*	85 kWh	107 kWh	133 kWh
Average kWh per mile**	0.9	0.9	0.9
Average range in miles	94	118	147
Worst-case kWh per mile**	1.3	1.3	1.3
Worst-case (winter) range in miles	65	82	102

Note:
EV = electric vehicle
kWh = kilowatt-hours
SMTD = Stateline Mass Transit District
* Usable battery capacity defined as the EV mid-life battery capacity calculated as 70% of nominal battery capacity. This definition assumes a 2% annual battery capacity degradation and a total of 20% capacity reserved for a combination of battery health and operational flexibility.
** Average and worst-case energy efficiency (kWh per mile) were calculated using assumptions and modeling efforts based on an area with similar operating and weather characteristics to those of the SMTD service area.

Battery/Energy Capacity Impacts on BEB Range

To calculate and model a battery's energy capacity, three factors must be considered: (1) battery degradation; (2) battery life; and (3) operational flexibility.

Battery Degradation

Batteries become less efficient and wear down over time as they are constantly charged and discharged. For example, as smartphone and laptop users are aware, as these devices grow older, they require more frequent charging as a "full charge" no longer provides power for as long as when the device was new. Based on manufacturer warranties, it is estimated that an EV's battery capacity degrades by as much as 2 percent per year. This rate of degradation is equal to a capacity loss of up to approximately 8 percent after 4 years (vehicle mid-life) and up to about 17 percent after 8 years (vehicle end-life).

Battery Life Capacity Reservations

Beyond general battery degradation, charging an EV to full capacity or charging it from a zero state of charge (SOC) increases battery degradation rates as additional strain is placed on the battery's physical and chemical components. All battery manufacturers recommend reserving a portion of the battery's capacity to preserve battery life to prevent a more rapid degradation of battery capacity than the annual 2 percent described above. The portion of a battery's capacity that is protected and unavailable for use varies by manufacturer and can range from approximately 5 percent to 35 percent of the battery's capacity. [8]

Operational Flexibility Capacity Reservations

Just as operators avoid driving a conventional vehicle until the fuel tank is empty, a portion of a vehicle's battery capacity is typically preserved for operational flexibility.[9] By preserving this capacity, transit agencies can increase the likelihood that BEBs will have sufficient range to return to the garage in the event of unseen delays or other unexpected events that would require a BEB to remain in service longer than originally planned.

Usable Battery Capacity Calculation Summary

Overall, SMTD's BEB service planning is based on a battery's usable rather than nominal, capacity at bus mid-life to account for battery degradation and capacity reservations. Based on an approximately 2 percent annual battery capacity degradation (but rounded up to 10 percent for a conservative estimate) and the reservation of 10 percent of battery capacity for battery life and 10 percent for operational flexibility, the usable battery capacity at the EV's mid-life (4 years) is calculated as 70 percent of the nominal (advertised) battery capacity.

Energy Usage Impacts on EV Range

Along with battery capacity, the amount of energy consumed by the EV (kWh/mile) also impacts EV range. Because the energy used to heat or cool the passenger cabin of a bus is the same energy that could be used for the propulsion of the vehicle, vehicle range can be substantially reduced in cold or hot weather, as increased energy must be devoted to maintaining a comfortable passenger cabin temperature. South Beloit, IL, sees a couple of months out of the year with average low temperatures below freezing, which can be detrimental to an EV's range as so much energy will be required to heat the interior.[10] Therefore, even though many transit agencies across the country can largely plan service assuming relatively warm average ambient temperatures, SMTD must plan service around worst-case range estimates based on winter temperatures to

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[8] National Renewable Energy Laboratory, *Electrifying Transit: A Guidebook for Implementing Battery Electric Buses* (April 2021).
[9] National Renewable Energy Laboratory, *Electrifying Transit: A Guidebook for Implementing Battery Electric Buses* (April 2021).
[10] Weather Spark, Climate and Average Weather Year Round in South Beloit (2022).

ensure reliable service can be maintained throughout all seasons. Drawing on the experience of other cold-weather agencies operating diesel-heated vehicles, this transition plan uses the same worst-case energy efficiency of 1.3 kWh/mile (mi) (see **Table 1**).

In addition to ambient temperature impacts, an EV's operational speed also influences energy usage and therefore EV range. Typically, slower speeds are a result of either busy or congested environments. In busy environments, EVs often see greater energy use, owing to doors being open more often and for longer periods of time. When the doors are open, vehicle cabin heating or cooling is more difficult, as extra energy needs to be drawn from the battery. In addition, when vehicles are stuck in congested environments, they spend an increased time idling and accelerating from rest, thereby also requiring greater energy usage.

Summary of EV Service Analysis Assumptions

Table 1 summarizes the battery capacity and energy usage assumptions and criteria discussed here and used to assess the suitability of EVs to SMTD's demand-response service. In recognition of the speed at which battery technology is advancing, three service analysis scenarios have been considered based on differing cutaway EV technology assumptions as quantified by the nominal battery capacity of the buses. The three scenarios are current technology (nominal battery capacity of 122 kWh), moderate technology improvement (nominal battery capacity of 146 kWh), and significant technology improvement (nominal battery capacity of 175 kWh). The current technology capacity was selected to align with the battery capacities commonly available in the current cutaway EV market, and the moderate technology improvement and significant technology improvement are each a 25 percent improvement over the previous scenario.

Demand-Response EV Service Analysis Results

To estimate the number of miles per vehicle per day for SMTD's fleet, two days of service were sampled. On sample day 1, average miles per van was 120 miles, with 27 percent of vehicles traveling less than 100 miles and 75 percent of vehicles traveling less than 150 miles. On sample day 2, average mileage was 139 miles, with 23 percent of vehicles traveling less than 100 miles and 61 percent of vehicles traveling less than 150 miles. Therefore, for this analysis, each demand-response vehicle within SMTD's fleet should be able to travel approximately 150 miles per day to qualify for a 1:1 replacement with an EV.

A 1:1 replacement is not feasible for SMTD's demand-response service under current technology or moderate technology improvement scenarios, as average operating conditions would not approach the approximate 150-mile range needed until the significant technology improvement scenario; however, even under the significant technology improvement scenario, additional vehicles would be needed to serve the worst-case scenario in the winter months, when more energy is needed to run onboard heating systems.

Overall, for SMTD to convert its fleet of demand-response vehicles, it would need to purchase additional vehicles that could be rotated throughout the day when a vehicle's battery drops below an established threshold SOC percentage. Once crossing this threshold, the vehicle would complete its current trip and then find a place to charge. The vehicle would not be dispatched to pick up another passenger; instead, a different vehicle with higher SOC would be dispatched.

Fleet Transition Projection

With the planned replacement of two-thirds of SMTD's existing fleet next year, the next vehicle would not be eligible for replacement until 2029. The three expansion vehicles entering service in 2024 will likely reduce the daily mileage requirement of the fleet and provide the flexibility required

for a fully electric fleet to swap out vehicles during the day. Also, battery range improvements over the next 6 years will likely exceed the capabilities of the BEBs we modeled for this report. As such, we have created a replacement plan that transition the fleet to BEBs on a 1:1 basis with its existing gasoline and diesel-powered vehicles.

Figure 4 shows SMTD's anticipated fleet transition through 2032, when all buses are anticipated to be electric.

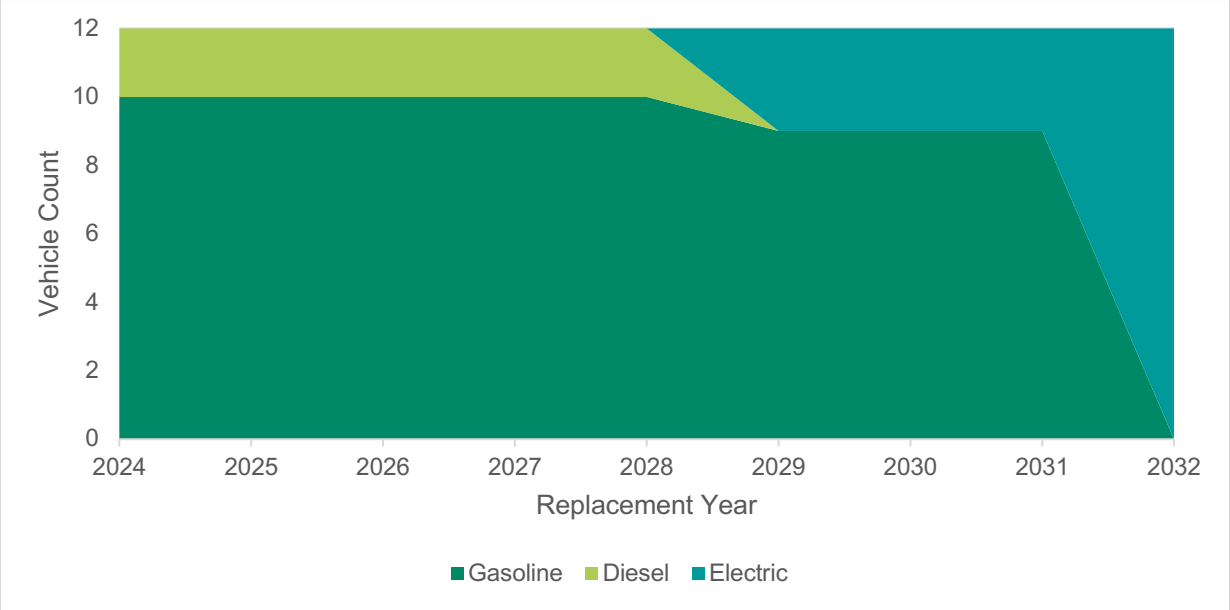

Figure 4: Fleet Composition Projection with Procurement Schedule

Facility Analysis

This section analyzes the suitability of RMTD's facility to accommodate SMTD's zero emission fleet. This section aligns with RMTD's Zero Emission Transition Plan, as RMTD is the operator of SMTD's service.

RMTD'S Current Facilities

The RMTD's combined Administration, Operations, and Maintenance Facility at 520 Mulberry Street in Rockford, IL, constructed over 30 years ago, was designed to store and maintain a fleet of 50 vehicles within an approximately 59,667 square foot ground floor maintenance and vehicle storage area. Over the past 30 years, the RMTD's fleet has expanded to 80 vehicles, which continue to be stored and maintained in this space. These space limitations restrict the RMTD's ability to safely and efficiently store and maintain the existing fleet and transition to an electric fleet by 2036. In addition to the storage situation noted above, RMTD also serves as a State of Illinois Regional Maintenance Center, further taxing RMTD's vehicle storage space when working on outside vehicles. With these constraints in mind, RMTD is currently planning an expansion to its facility to accommodate the additional space it needs to operate its services with zero-emission vehicles.

Battery Electric Bus Facilities Assessment Overview

Scaling to a fleetwide BEB 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.

However, full fleet deployment of BEBs would 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 the detailed electrical and construction drawings required for permitting, is also necessary once the specific charging equipment has been selected.

To determine the installation timeline and costs for the charging equipment, this assessment breaks the infrastructure scope of work into three key project types: planning, power upgrades, and installation of the charging equipment (charger and dispensers). The estimated costs associated with the three project types are listed in **Table 2**.

Table 2: Battery Electric Bus Infrastructure Project Costs

Project	Estimate Metrics	Cost Estimate	Source
Infrastructure planning	Infrastructure planning and design	$200K per project	Engineer's estimate
Power upgrade projects	Design, construction & equipment	Variable ($200K–$400K) per project depending on capacity added	Engineer's estimate; includes 20% contingency
Charging installation projects	Charging equipment & installation	$132K per 150 kW charger $12K per dispenser	Quotes and estimates, include 20% contingency.

Note:
kW = kilowatts

The key assumptions applied to RMTD'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
- Dispenser capacity to serve up to 80 percent of the fleet at a time; no movement of buses overnight.

Battery Electric Bus Infrastructure Cost Summary

It is anticipated that RMTD will include SMTD's needs when performing the infrastructure planning and power upgrades necessary to service both fleets. The two agencies may share these costs on a proportionality that will need to be agreed to by both organizations. However, based on the information in the previous section, it can be estimated that the charging equipment for SMTD's fleet will cost approximately $936,000 in 2023 dollars (based on twelve vehicles), which includes a 20 percent contingency.

Resource Availability

Utility Coordination

RMTD has been in communication with Commonwealth Edison/Exelon, which has been a key partner in assessing RMTD's current capacity and planned facility expansion project. The relationship between RMTD and the energy supplier will be valuable as RMTD executes its transition plan. RMTD plans to use any applicable EV rate schedules, or incentive programs offered by potential generators, to inform its decision about which contract to purchase.

RMTD is aware that taking advantage of these benefits and ensuring a successful BEB deployment require close, ongoing coordination with Commonwealth Edison/Exelon. RMTD's discussion of short- and long-term fleet goals with Commonwealth Edison/Exelon ensures that the utility can properly plan grid-side electrical infrastructure upgrades and that RMTD can adequately upgrade behind-the-meter equipment to support BEBs. Once the infrastructure upgrade needs are established, RMTD will incorporate the design and construction timelines into the overall transition plan timeline.

RMTD recognizes Commonwealth Edison/Exelon as a critical partner in electrification and will continue to partner with Commonwealth Edison/Exelon after the planning stages, so that charge management strategies and fleet expansion efforts, including SMTD's fleet, can be coordinated effectively.

Funding Availability

BEBs and their associated infrastructure require additional funding beyond that which is usually available for transit vehicle acquisition due to the additional costs associated with the technology, such as charging infrastructure. Some funding programs identified as being available to SMTD to help with these costs are discussed below.

Federal Funding Sources

- United States Department of Transportation (USDOT)
    - Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grants
- FTA
    - Bus and Bus Facilities Discretionary Grant
    - Low- or No-Emission Vehicle Grant
    - Urbanized Area Formula Grants

Illinois Funding Sources

- Illinois Department of Transportation Downstate Transit Capital Program
- Transportation Development Credits
- Consolidated Vehicle Procurement Program

Workforce Development & Training

To prepare for the transition to zero-emission vehicles, SMTD's service operator, RMTD, has put together a Workforce Development Plan that focuses on ZEB operations and maintenance. This program will be undertaken in consultation with labor representatives and will continue to build on a current apprenticeship program that is already in the works to determine how to best reskill and

upskill the current workforce to meet the needs of RMTD's future operational and maintenance needs.

Workforce Analysis Overview

Developing and training the workforce required to operate and maintain ZEBs requires significant investment and planning. RMTD is experienced in recruiting, hiring, training, and integrating new staff to ensure that employees are qualified to provide quality services to its riders. The level of training that RMTD staff engage in on hiring is dependent on their level of experience at that time. RMTD recognizes that a trained ZEB workforce is not readily available, and the transit industry must address the shortage of technicians and mechanics together. RMTD has been in touch with the labor unions that represent their staff (bus operators are Amalgamated Transit Union and maintenance are International Brotherhood of Electrical Workers). RMTD has shared information not only about the upcoming deployment later this year but also about the agency's goal of transitioning to 100 percent ZEVs.

RMTD 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 systems. Meaningful investment is required to upskill maintenance staff and bus operators that were originally trained in diesel 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. RMTD's workforce development activities will address the identified skills and tools needed for each relevant team.

Identified Training Needs

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

1. *Vendor training from Gillig Transit Bus Manufacturing (GILLIG), ChargePoint[11], and other equipment or service providers.* RMTD plans to take advantage of trainings from the bus manufacturers and infrastructure suppliers, including maintenance and operations training, 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. RMTD training staff will work closely with the OEMs providing vehicles to ensure all mechanics, service employees, and bus operators complete necessary training before the deployment of ZEB technology. RMTD staff will also be able to bring up any issues or questions they may have about their training with their trainers. Trainers will observe classes periodically to determine if any staff would benefit from further training.
2. *ZEB tools*. RMTD currently has laptops and digital multi-meters. Future upgrades of these tools will be necessary to maintain BEBs for maximum efficiency and longevity. RMTD will also need to purchase personal protective equipment to ensure the safety of their workforce.

[11] ChargePoint is RMTD's vehicle charging system provider

3. *National Transit Institute Training.* RMTD will review and consider course offerings for future trainings.

4. *Local Partnerships and Collaborations.* RMTD is working with Rock Valley College in Rockford, IL, to enhance the college's education and training programs in the field of electric battery propulsion. Rock Valley College is eager to offer students internship or apprenticeship experiences at the RMTD facility to train on zero-emission vehicles.

5. *Professional Associations.* RMTD is a current member of the Zero Emission Bus Resource Alliance (ZEBRA), a professional organization of 48 transit agencies from across the U.S. and Canada. ZEBRA is the only transit working group that consists solely of transit agencies operating ZEBs and is leading the way, with more than 310 ZEBs in service. ZEBRA offers space for sharing lessons learned, collaborating on deployments, and interpreting performance trends. As part of RMTD's workforce development strategy, development and training for all levels of its team, including the executives, managers, and technical staff that represent the agency, are of critical importance to better understand ZEBs and make informed performance, maintenance, operating, and purchasing decisions related to zero-emission vehicles and infrastructure.

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.

RMTD will perform BEB familiarization and safety training before taking possession of vehicles. Once BEBs are delivered, RMTD will complete OEM and ChargePoint training with maintenance staff, bus operators, and operations staff.

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, RMTD will employ training strategies that support additional zero-emission vehicle deployments in the future.

Conclusion

Although SMTD is not likely to introduce a battery electric vehicle into its fleet for a few years, it is well positioned to be ready for the day when the first BEB bus enters its fleet.

Next Steps

The next steps identified to move the SMTD fleet transition forward include the following:

- Monitor the develop of small transit BEB technology to determine if future vehicles can replace its existing fleet on a 1:1 basis.
- Continue coordination with RMTD to ensure that its future facility improvements meet SMTD's fleet needs.
- Prepare a procurement/contract for BEB vehicles.

Updates to the Transition Plan

This transition plan is reflective of zero-emission technology as it exists today. The technology is rapidly evolving and, with the increased acceptance of these vehicles into large fleets, will likely improve its performance. It would be beneficial for the agency to update this plan every 3 to 5 years, much like it might a long-range strategic plan, to ensure it takes advantage of current technology and the efficiencies it will likely bring.

Appendix A: Rockford Mass Transit District
FTA Zero-Emission Fleet Transition Plan

Rockford Mass Transit District (RMTD):
FTA Zero-Emission Fleet Transition Plan

Table of Contents

Introduction

Rockford Mass Transit District (RMTD) developed this Zero-Emission Fleet Transition Plan to meet the requirements of 49 U.S.C. 5339(c)(3)(D) for applicants to the *FY2022 Low or No Emission Grant Program (Low-No)* and/or *the Grants for Buses and Bus Facilities Competitive Program (BBF)*. This fleet transition plan was developed specifically for this application and includes reference to the project(s) requesting FY22 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

Fleet Assessment Overview

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

The Rockford Mass Transit District provides Fixed Route and Paratransit Service to the cities of Rockford, Loves Park, and the Village of Machesney Park. RMTD's fleet is comprised of 74 fixed route vehicles, 8 vehicles are owned by Stateline Mass Transit District (SMTD) which RMTD operates and maintains. RMTD operates 17 fixed routes Monday through Saturday, and 5 routes on Sundays in Rockford. All vehicles are housed at 520 Mulberry Street, Rockford, Il. Buses range in age from model year 2007 to 2020; the average age is 10.6 years for fixed route and demand response is 6 years.

The first step in the Fleet Assessment is determining the schedule for replacing RMTD's current fleet with ZEBs. For the purpose of the FY22 Low-No and Buses and Bus Facilities applications and based on RMTD's goals and current fleet replacement plan, RMTD developed the following Annual ZEB Purchase Schedule presented below in **Table 1.**

Table 1: Annual ZEB Purchase Schedule

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	6	12	15	16	0	3	7	0	0	0	9	16	13	15	13	8	0	0
Number of ZEBs Scheduled to Enter Service	0	6	6	5	8	0	2	7	0	0	0	9	16	13	15	13	8	0	0
ZEB Percentage of New Buses	0%	100%	50%	33%	50%	0%	67%	100%	0%	0%	0%	100%	100%	100%	100%	100%	100%	0%	0%

In this schedule, vehicles are replaced once they have come to the end of their useful life with a battery electric vehicle up to the given percentage of replacements as determined by the Annual ZEB Purchase Schedule. This assessment assumes that the fleet will increase in size by six vehicles in 2023.

RMTD will begin deploying ZEBs in 2022; RMTD is currently in the procurement process for six ZEBs to be delivered later this year. RMTD will reach 100% ZEV procurement by 2029. RMTD's FY22 Low-No and Buses and Bus Facilities projects are reflected in the second procurement year.

Key Results

Figure 1 shows RMTD's projected purchases by year including the number and type of bus propulsion through 2038. The proposed FY22 Low-No and Buses and Bus Facilities projects is reflected in **Figure 1,** with RMTD procuring 6 battery electric buses, and 6 diesel hybrid buses in 2024. This year, RMTD has a need for 12 buses, however at this time, because of the range imitations, RMTD will augment their fleet with hybrids. The long term plan is to replace those vehicles with ZEVS at the end of their life. RMTD is currently in the process of procuring their first battery electric vehicles which will be delivered later this year. While those vehicles have been purchased and will be deployed this year, 2023 will be the first full year of deployment so they are represented in **Figure 1** in the year 2023.

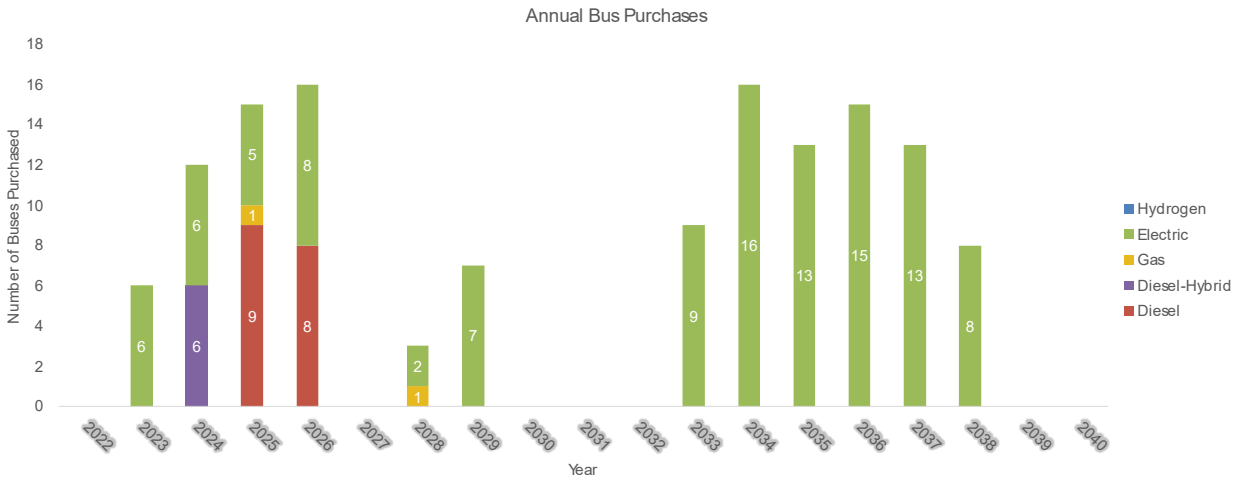

Figure 1 – Projected Bus Purchases

Figure 2 depicts RMTD's proposed annual fleet composition through 2040 as it phases out previous vehicle propulsion technologies for ZEBs. By 2038 the agency's fleet is 100% ZEBs.

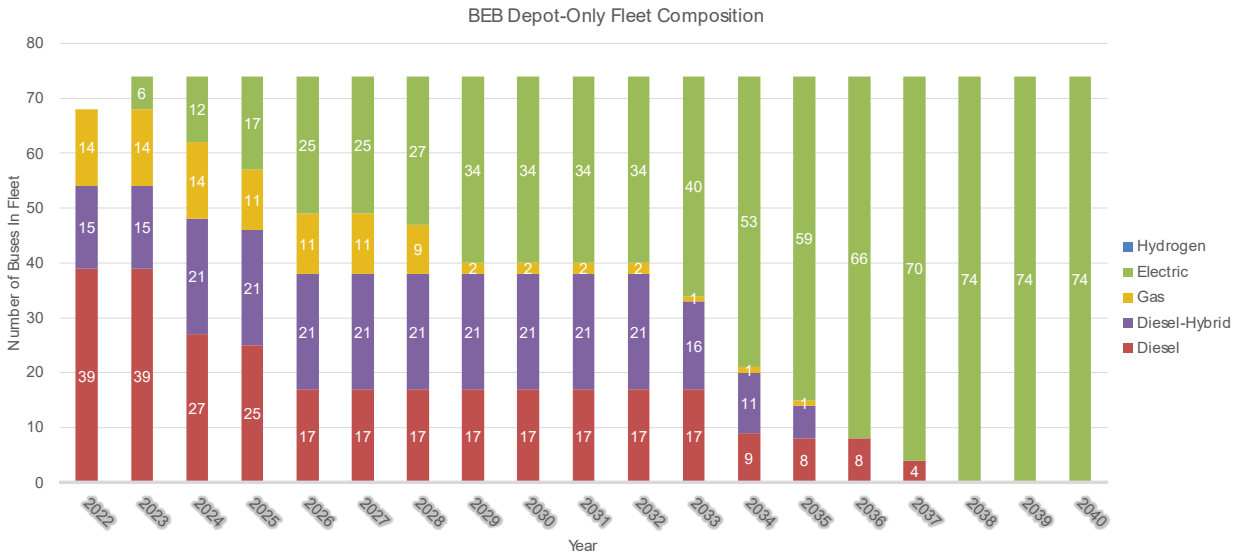

Figure 2 – Annual Fleet Composition

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.

Figure 3 shows the annual capital costs for vehicles purchased in a given year 2038. The estimated total cost for vehicles over the designated transition period is $76,986,066. Costs are incurred from the annual ZEB purchases laid out in the fleet replacement plan.

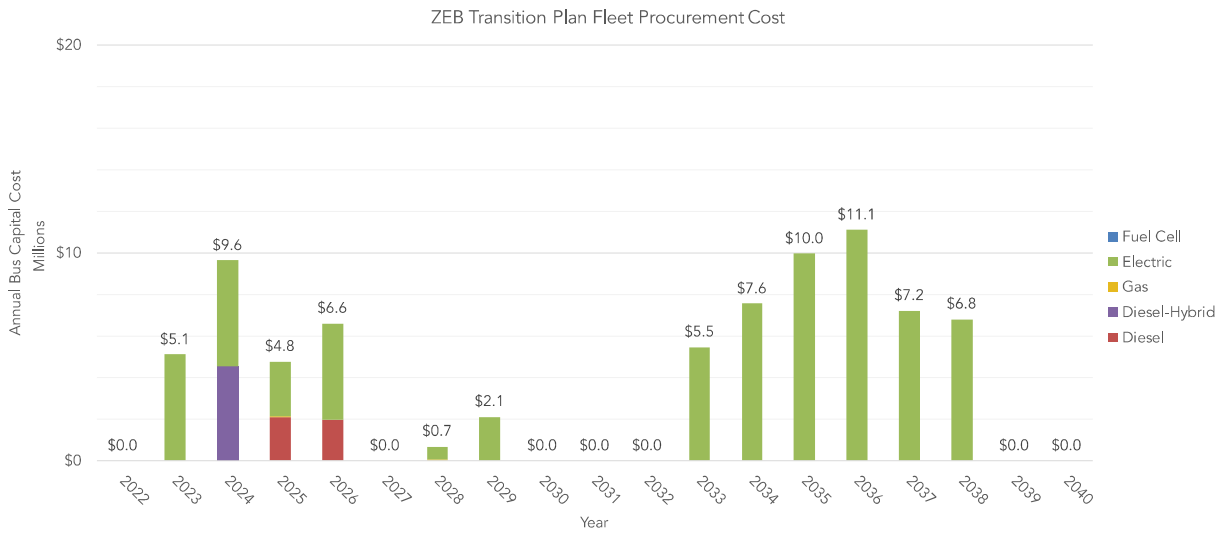

Figure 3 – Annual Capital Costs

Conclusion

RMTD is expected to reach transition to a zero emission fleet by 2038. The expected total capital cost of vehicles for the transition to a ZEB fleet is estimated at $76,986,066.

Element 2: Funding Needs Assessment

Funding Assessment Overview

RMTD 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 $750,000 and $1,200,000, which is approximately $250,000 to $700,000 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 RMTD's budget to better understand funding gaps and needs.

RMTD Funding Needs

Over the course of the transition period, RMTD plans to meet the District's Sustainability Policy of 100% zero-emission vehicles by 2036. With the vehicles currently being procured, RMTD is confident in the ability to reach this goal by 2038. RMTD underwent a facility assessment and

master plan which identified facility needs, and recognized the alignment with the District's Sustainability Policy goals.

To achieve these goals and move towards a successful deployment of zero-emission buses, RMTD projects will require $85,575,066 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 RMTD's current projections, RMTD must identify resources that can cover this funding gap. Traditional formula funding 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 RMTD will require additional funding to offset the higher costs associated with zero-emission technology.

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

Federal Funding sources RMTD is considering include:

- United States Department of Transportation (USDOT)
    - Rebuilding American Infrastructure with Sustainability and Equity (RAISE) Grants
- 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
- Environmental Protection Agency (EPA)
    - Environmental Justice Collaborative Program-Solving Cooperative Agreement Program

RMTD has secured funding through the Illinois Department of Transportation (IDOT) Downstate Transit Capital program to fund a portion of the current procurement, as well as the first phase of

the planned facility expansion. Additional funding through this program will be used to complete the facility expansion.

The City of Rockford, in conjunction with IDOT was awarded a Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant for the purpose of a Complete Streets project in Rockford. One part of the project is a downtown circulator, which will operated by three battery electric buses. The funding has been secured, but a purchase has not yet been made.

RMTD has applied for Transportation Development Credits through the State of Illinois and IDOT.

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. RMTD 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. RMTD 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. RMTD's goal to deploy zero emission vehicles supports the federal administration priorities of safety, modernization, climate, and equity for public transportation. RMTD provides transportation to four communities in the Rockford Region offering an essential service to a proportionately higher population of minority, low-income, and disadvantaged groups who otherwise may not have access to employment, medical appointments, shopping and recreation. Replacing the RMTD's current diesel buses with battery electric and hybrid electric buses, will enable RMTD to continue to deploy clean technologies in a comprehensive and equitable manner to transit dependent populations throughout the entire RMTD service area.

Illinois Policies & Goals

In 2019, Illinois entered into the U.S. Climate Alliance committing to the actions below:

- Implement policies that advance the goals of the Paris Agreement, aiming to reduce greenhouse gas (GHG) emissions by at least 26-28 percent below 2005 levels by 2025.
- Track and report progress to the global community in appropriate settings, including when the world convenes to take stock of the Paris Agreement.
- Accelerate new and existing policies to reduce carbon pollution and promote clean energy deployment at the state and federal level.

Based on RMTD's history of operations, and encouragement from state policy makers, there are no state policies or legislation will hinder implementation of this plan.

Support for Local Policy Goals

In 2018 RMTD adopted a Sustainability policy committing to the goal of a zero-emission fleet by the year 2036. Earlier this year, RMTD created and submitted a Climate Action Plan as part of the FTA's Healthy Planet Challenge. This plan, named by the FTA as a "Champion of the Challenge" award winner for 2022, outlines 30 actionable strategies to achieve sustainability in all aspects of RMTDs operation including the goal of a zero-emission fleet.

Element 4: Facilities Assessment

Facilities Assessment Projects

The following section introduces the timeline and cost estimates for the infrastructure associated with RMTD's transition to battery electric buses.

RMTD'S Current Facilities

The Rockford Mass Transit District's (RMTD) combined Administration, Operations, and Maintenance Facility at 520 Mulberry Street in Rockford, Illinois, constructed over 30 years ago, was designed to store and maintain a fleet of 50 vehicles within the approximately 59,667 square foot ground floor maintenance and vehicle storage area. Over the past 30 years, the RMTD's fleet has expanded to 80 vehicles, which continue to be stored and maintained in this space. These space limitations restrict the RMTD's ability to safely and efficiently store and maintain the existing fleet and transition to an electric fleet by 2036. In addition to storage situation noted above, RMTD also serves as a State of Illinois Regional Maintenance Center further taxing RMTD's vehicle storage space when working on outside 5310/5311 vehicles.

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 2**.

Table 2 – 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	$132k 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 RMTD's transition to a battery electric bus fleet. The estimated total infrastructure costs are approximately $8,589,000. This total cost includes power upgrade projects, charger and dispenser installations, planning projects, design-engineering costs, and a 20% contingency on all costs.

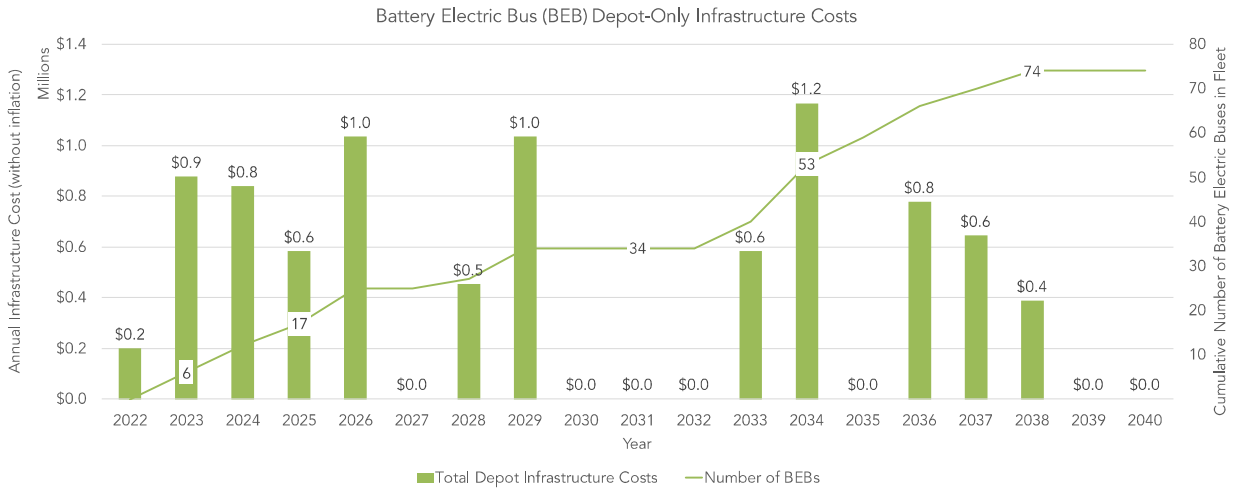

Figure 4 - Depot Only Annual Costs, Infrastructure

The total number of each infrastructure type included in this cost analysis is included in **Table** *3*.

Table 3: Infrastructure Summary

Infrastructure Element	Total Quantity Required (2022 – 2040)
Planning and Design	*1*
Chargers	*35*
Dispensers	*70*
Added Service Capacity	*6MW*

Element 5: Partnership Assessment

Battery Electric Bus Partnership

Establishing and maintaining a partnership with the local electric utility is critical to successfully deploying zero-emission vehicles and maintaining operations. With the addition of battery electric buses to a fleet, a transit agency may likely become a utility's largest customer with added implications for grid-side infrastructure and agency operational costs. Early coordination and discussions can avoid costly delays and misaligned operational strategies while also revealing opportunities for lower operational costs and smart investments. Fortunately, electric utilities are

beginning to develop electric vehicle rates and streamlined processes for charging infrastructure interconnections that can support successful zero-emission fleet deployments.

RMTD has been in communication with Commonwealth Edison/Exelon, who has been a key partner in assessing RMTD's current capacity and ability with the planned bus and charger deployment for later this year, as well as the planned facility expansion project. The relationship between RMTD and the energy supplier will be valuable as RMTD executes this plan. As of the writing of this plan, Aggressive energy is the energy generator for RMTD; the purchase contract ends in July of 2022. RMTD plans to use any applicable EV rate schedules, or incentive programs offered by potential generators to inform a decision on contract to purchase.

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

RMTD recognizes Commonwealth Edison/Exelon as a critical partner in electrification and will continue to partner with Commonwealth Edison/Exelon after the planning stages, so that charge management strategies and fleet expansion efforts can be coordinated effectively. Additionally, Commonwealth Edison/Exelon has issued a letter of support for RMTD include in attachment I.

Element 6: Workforce Analysis

RMTD, located in Rockford, Illinois, operates a fleet of 41 Fixed Route vehicles, including 6 battery electric buses to be deployed later this year. The agency is a leader in transitioning to ZEBs and has been committed to the goal of a zero-emission fleet by the year 2036. In order to support ZEB operations at this scale, RMTD has identified opportunities ensure the current and future workforce is prepared to manage its full fleet of more than 82 future ZEBs. This Workforce Development Plan focuses on ZEB operations and maintenance.

In alignment with FTA's requirements under the Workforce Development for the 2022 Low No program, RMTD will build a ZEB workforce program in consultation with labor representatives, and will continue to build on a current apprenticeship program already in works and determine how to best reskill and upskill the current workforce to meet the needs of RMTD's future operational and maintenance needs.

Workforce Analysis Overview

Developing and training the workforce required to operate and maintain zero-emission buses requires significant investment and planning. RMTD 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 RMTD staff engage in upon hiring is dependent upon their level of

experience at that time. RMTD recognizes that a trained ZEB workforce is not readily available and the transit industry must address the shortage of technicians and mechanics together. RMTD has been in touch with the labor unions (bus operators are Amalgamated Transit Union and maintenance are International Brotherhood of Electrical Workers) that represents their staff. RMTD has shared information not only about the upcoming deployment later this year, but also about the agency's goal of transitioning to 100% ZEVs.

RMTD 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 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. RMTD's workforce development activities will address the identified skills and tools needed for each relevant team.

Completed Trainings

RMTD will pursue OEM-provided trainings from Gillig and ChargePoint. RMTD also has future plans for ZEB training through the West Coast Center of Excellence in Zero Emission Technology (CoEZET) training hosted by SunLine Transit.

Identified Training Needs

Several training needs have been identified by RMTD staff in order to support their transition to a 100% ZEB fleet. RMTD 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 RMTD's fleet expands. As such, the following training plans are intended to provide a framework.

1) *Vendor training from GILLIG, ChargePoint, and other equipment or service providers*
   RMTD 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. RMTD 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. RMTD 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.
2) *ZEB tools*
   RMTD currently has laptops and digital multi meters. Future upgrades of these tools will be necessary to maintain BEBs for maximum efficiency and longevity. RMTD will also need to purchase Personal Protective Equipment to ensure the safety of their workforce.
3) *National Transit Institute training*

RMTD will review and consider course offerings for future utilization.

4) *Local Partnerships and Collaborations*
   RMTD is working with Rock Valley College in Rockford, IL to enhance the college's education and training programs in the electric battery propulsion field. Rock Valley is eager to offer students internship or apprenticeship experiences at the RMTD facility to train on zero emission vehicles.
5) *Professional Associations*
   RMTD is a current member of the Zero Emission Bus Resource Alliance (ZEBRA), a professional organization of 48 transit agencies across the U.S. & Canada. ZEBRA is the only transit working group that consists solely of transit agencies operating ZEBs and is leading the way with more than 310 ZEBs in service. ZEBRA offers space for sharing lessons learned, collaborating on deployments, and interpreting performance trends. As part of RMTD's workforce development strategy, development and training for all levels of our team, including the executives, managers, and technical staff that represent our agency, is of critical importance to better understand ZEBs and make informed performance, maintenance, operating, and purchasing decisions related to zero-emission vehicles and infrastructure.

Resources and Strategies to Meet Identified Needs

In order to incorporate the above training needs, RMTD envisions using the following resources and strategies. To achieve these goals and ensure a successful deployment of zero-emission buses, RMTD will require approximately $735,000 in funding to cover the workforce development initiatives identified. FY2022 Low-No funding will ensure the workforce development plan can be implemented in parallel with deployment of vehicles and infrastructure.

Table 4: Training Resources

Training Resource/Strategy	FY2022 Low-No Budget
Bus OEM Operator, Maintenance, First Responder Training	$100,000
PPE, Tools, and Equipment	$10,000
Rock Valley College Partnership	$600,000
CTE ZEB 101 Training	$20,000
Additional Operator Training	$5,000
Professional associations	excluded

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 RMTD's fleet transition plan of becoming 100% ZEV by 2038, the graphic below shows the anticipated progression. By 2025, RMTD will have a battery electric fleet of 74 buses, which is roughly 25% of the total fleet. By 2038, RMTD will have a battery electric fleet of 74 buses and be 100% zero-emission.

RMTD will perform battery electric bus familiarization and safety training prior to taking possession of vehicles. Once BEBs are delivered, RMTD will complete OEM and ChargePoint training with maintenance staff, bus operators, and operations staff.

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, RMTD will employ training strategies that support additional zero-emission vehicle deployments in the future.