pace

Project Zero

Zero Emissions Bus Facility Plan

February 2024

Table of Contents

List of Figures

List of Tables

Appendices

Executive Summary

Under our 2021 strategic vision plan, *Driving Innovation*, Pace Suburban Bus made a bold promise to the Northeastern Illinois region and its nearly 8.4 million people.

To improve the health and well-being of our region's residents and environment well into the future, Pace committed to transitioning 100 percent of its fixed-route fleet to zero-emissions buses (ZEBs) by 2040, eliminating more than 900,000 tons of CO2 from the atmosphere.

As an award-winning and nationally-renowned transit agency, Pace takes our Project Zero commitment seriously. The agency started in earnest, purchasing its first zero-emissions bus in fall 2022. In winter 2022, the agency released its complete *Zero-Emission Bus Transition Plan* (**Appendix C**) to comprehensively outline the funding needed to realize our 2040 goal and the efforts needed to train and familiarize our staff with ZEB service, maintenance, and operations. The agency is also assessing the capabilities of our facilities and garages, which require significant investment in modifications that will best support a full-scale ZEB rollout. This new report, the *Zero Emissions Bus Facility Plan*, details the many requirements for operating a ZEB fleet, and it helps set the stage for Pace to deploy electric buses on our region's roads in the coming years.

Map of Routes Operated by Pace

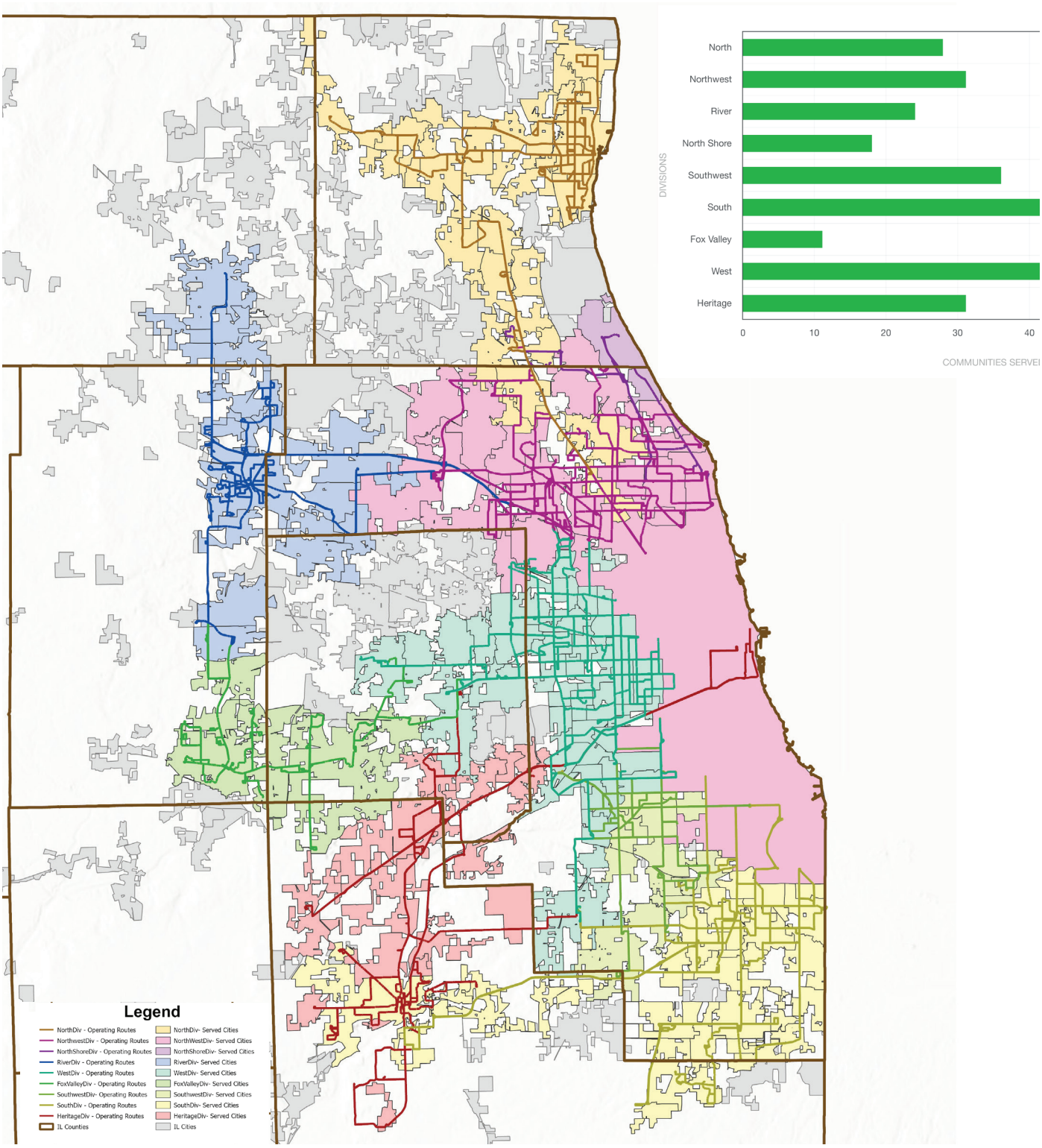


Figure 1: Number of Communities Each Division Serves

The two technologies currently available in the transit vehicle market that power zero-emissions vehicles are hydrogen fuel cell electric buses (FCEBs) and battery electric buses (BEBs). FCEBs offer mileage ranges similar to traditional diesel and compressed natural gas (CNG) buses. However, the availability of affordable liquid hydrogen for fueling is limited as the network of hydrogen production facilities in the United States is still growing. The closest hydrogen producer to Pace's service area is located in East Chicago, Indiana, about 20 miles from Pace's South Division in Markham, Illinois. To further grow the hydrogen production and distribution market, the U.S. Department of Energy (DOE) has awarded a total of $7 billion to seven applicants to build hydrogen hubs in different regions of the United States, which will lead to greater availability and lower costs. Until hydrogen production and distribution grow enough nationwide to lower the price of the fuel, Pace is leveraging the more mature BEB technology to start its fleet transition.

Pace's Zero Emissions Facility Transition Plan is a companion document to Pace's 2022 Zero-Emission Bus Transition Plan, which details the agency's transition to a zero emissions fixed route fleet by 2040.

This Facility Plan describes the necessary phased improvements at each of Pace's nine operating divisions across the Northeastern Illinois region as ZEBs begin to enter the fleet. The timing of the Facility Plan aligns with ongoing improvements to many Pace garage facilities. For the past four decades, Pace's operations have grown significantly throughout the six-county service area without major expansions to its garages. The Facility Plan focuses on seven of Pace's operating divisions. Pace's West and Heritage Divisions were not evaluated due to recent midlife/construction and will be reevaluated in five years when this plan will go through an update based on transition progress.

Pace is currently designing South Division as a hydrogen facility, as it was subject to midlife improvements and converted into a CNG bus maintenance facility in 2016.

In 2018, Pace purchased a 400,000-square-foot former printing and warehousing facility in Wheeling with the idea of converting it to a garage that could house CNG buses and replace Pace's Northwest Division facility in nearby Des Plaines. Farther west, in suburban Elgin, the agency also recently began construction engineering to expand the River Division facility, securing state capital funding for the project. Similarly, Pace has also secured the funding necessary to improve and expand Southwest and North Shore garages. While plans were in the works to expand many facilities, the transition to a zero-emissions fleet has required design modifications and a greater financial commitment to ensure that significant infrastructure upgrades needed to support the charging and maintenance of BEBs are made.

To that end, the Facility Plan outlines Pace's requirements for operating a ZEB fleet and details the local improvements that can support the initial wave of BEBs. The Facility Plan also details the phased installation of supporting infrastructure to seamlessly integrate additional ZEBs in the future.

The report features five sections, as outlined below.

1 Transition Planning

Analyzes how Pace's current bus routes and the state of battery technology inform a phased transition plan for modernizing facilities.

2 Power Requirements

Describes Pace's ongoing coordination with Commonwealth Edison (ComEd), northern Illinois' electrical utility, to plan for and provide the additional power needed to support electric vehicles at all divisions (3x the current capacity), and to enable Pace to maintain its ability to provide support and service in the event of regional power supply disruptions or outages. It also describes the equipment needed for charging and back-up support in the event of power outages and power supply disruptions.

3 Facility Modifications

Summarizes the existing conditions and planned modifications for each facility and examines potential issues with construction, zoning, and applicable environmental regulations. It assesses parking capacity at Pace garages since BEBs require fixed charging locations, making it harder to rearrange vehicles and storage space. It also identifies potential expansion efforts that can better address challenges with storage and charging.

4 Funding

Outlines funding challenges and opportunities associated with fleet electrification, including existing and potential funding sources. Pace will need the support of our regional, state, and federal partners to assist with capital funding and ensure a seamless transition that can meet our environmental goals and best serve our customers.

5 Next Steps

Suggests next steps that can guide future efforts to modernize facilities. With zero-emissions technology rapidly evolving, Pace will need to periodically update transition plans to account for anticipated technological advances and assess their impact on planned vehicle purchases and facility upgrades.

1 Transition Planning

As described in ***Project Zero: Zero-Emission Bus Transition Plan***, Pace worked with STV, a consultant with Pace's Project Management Oversight team, to analyze current service using PEER, a dynamic modeling software.

The Performance Evaluation of Electric bus Routes (PEER) simulation evaluated BEB performance using Pace's vehicle blocking schedule, which details a Pace vehicle's daily assigned travel and can include multiple routes. PEER compares energy consumption, block completion, and a bus battery's remaining capacity, referred to as State of Charge (SOC), under various operating conditions. The PEER simulation also determined the future power requirements for each of Pace's operating facilities to support charging a BEB fleet.

Data inputs included fleet size and make up, standardized General Transit Feed Specification (GTFS) schedule information, ridership statistics, stop elevation profiles, and ambient temperatures. The output data determined the required number of buses and the portions of the current blocking schedule that were completed using BEB technology and vehicles charged only at garages. The model provided options to address blocks that could not be completed. Those included schedule adjustments to dedicate more buses to current blocks, on-route charging to extend a vehicle's range, and alternative engine systems like FCEB. The results also forecasted how anticipated advances in battery capacity will increase the percentage of completable schedule blocks as Pace's fleet transition progresses.

Appendix B includes the full PEER Analysis and **Appendix D** includes a schedule that summarizes the level of implementation. **Table 1** shows weekday block completion rates for Pace's nine operating divisions using current and future battery technologies. The calculations assume a 20 percent degradation in battery capacity over 6 to 10 years. Current batteries for 40-foot buses have 518kWh advertised capacity which equates to 414kWh of service energy. Future batteries are assumed to have an advertised capacity of 800kWh which equates to 640kWh of service energy. The block completion rates reflected in Table 1 are based on winter operating conditions that considered diesel-fired heaters that would increase a battery's capacity and extend the range of the buses on frigid days.

Table 1: Completion Rates for Weekday Blocks Under Different Battery Conditions

Division	Number of Blocks	Current Battery Technology		Future Battery Technology	
		Block Completion New [1]	Block Completion Degraded [2]	Block Completion New [3]	Block Completion Degraded [4]
North	74	92%	80%	100%	100%
Northwest Wheeling	155	72%	66%	94%	86%
River	91	65%	57%	95%	75%
North Shore	71	90%	83%	100%	96%
Southwest	75	77%	69%	96%	88%
South	129	77%	67%	98%	84%
Fox Valley	58	79%	62%	100%	98%
West	178	78%	71%	96%	84%
Heritage	86	72%	59%	95%	91%

Source: Pre-Covid, 2019 General Transit Feed Specification (GTFS) data utilized to perform the PEER analysis

1. 518kWh advertised capacity, 414kWh service capacity
2. 331kWh
3. 800kWh advertised capacity, 640kWh service capacity
4. 512kWh

According to the PEER analysis, BEBs using current battery technology can only complete between 57 to 83 percent of schedule blocks, so Pace's entire diesel fleet cannot currently be replaced at a 1:1 ratio with BEBs. However, modeling with the increased battery capacity of projected future technology, block completion rates increased to between 75 and 100 percent. For divisions where block completion does not reach 100 percent, schedule changes or additional BEBs may be required to complete the full schedule. For example, the service at River Division may require scheduling modifications or fleet expansion since its block completion rate was only 75 percent when modeling with future battery technology. Going forward, as battery capacities increase through technological advancements, ongoing efforts to optimize schedules will enable Pace to revisit BEB fleet requirements and procurement strategies to meet service goals. If battery capacities do not reach anticipated levels, more BEBs may be required to operate longer blocks, or FCEBs may emerge as a more viable ZEB alternative to meet service needs.

1.1 INITIAL TRANSITIONS

Given the fleet replacement timeline outlined in the Zero-Emission Bus Transition Plan and the projected useful life of facility improvements, Pace recognized the need to reevaluate its development plans to facilitate the agency's goals to deliver zero-emissions transit service by 2040. To that end, North, Northwest Wheeling, and River Divisions are the first to advance to a 30 percent level of design and will go into final design to align with the fleet transition schedule. North Division in Waukegan will be the first garage to house a fully battery electric fleet by 2027 and was selected first due to its average length of routes and its ability to adapt and accommodate BEBs. North Division was also selected as the first operating division to be converted as it predominantly serves communities of color and historically disadvantaged populations. Replacing diesel buses with BEBs reduces air pollutants, improves equity, opportunity, and environmental justice to disadvantaged minority populations. The facility and fleet will be converted in two phases based on the timed replacement of diesel vehicles. The first 12 BEBs are scheduled for delivery in 2024, and will be stored and charged outside. The facility will ultimately store up to 60 BEBs indoors after the second phase of the conversion.

At other divisions, Pace started planning replacement and expansion projects before the zero-emissions transition due to the facilities' limited and aging spaces. Built in 1962, Northwest Division was designed to accommodate a fleet of approximately 64 vehicles. Over time, the service provided by the garage grew exponentially. The division now houses 126 vehicles, the majority of which are parked outdoors. To address these needs and plan for future service expansions, Pace purchased a 400,000-square-foot printing and warehouse facility in Wheeling with the intent to convert the property into an operating facility that could support lower emission CNG vehicles and replace the Des Plaines garage.

Similarly, River Division in Elgin was constructed in 1989, and the facility no longer has sufficient capacity for its growing operations. To address these space constraints, Pace is leasing a garage facility in East Dundee to supplement its vehicle storage capacity. Pace also acquired a larger piece of property adjacent to River Division with long-term plans to eliminate those annual leasing costs, expand indoor parking, increase maintenance capacity, and modernize the division's administrative and driver spaces.

2 Power Requirements

Implementation of BEBs will require significant upgrades to the electrical service capacity at each facility.

Each of Pace's facilities will require significant upgrades to strengthen electrical service capacity and support BEBs. The PEER software analysis determined the amount of increased power needed at each facility, supplying data that helps plan the necessary electrical supply upgrades and supporting infrastructure at each of Pace's operating divisions. The total current power service to all of Pace's divisions is 11.85MW, while powering a 100 percent BEB fleet will require an additional 39.52MW of power, a 333 percent increase. Because the zero-emissions transition demands significant increases in power supply, Pace has worked with ComEd to bring in a centralized Multi-Site Customer Service Account Manager who serves as a single point of contact for all Pace projects. The Pace project team meets regularly with the ComEd team as work advances on the North, Northwest Wheeling, and River Division projects. Pace will continue to work closely with ComEd to ensure the vehicle delivery and facility modernization timelines align with ComEd's plans to increase power delivery.

ComEd's Regulatory Distribution Extension Rider (Rider DE) can affect power service upgrades. Rider DE allows ComEd to evaluate major improvements to power grid infrastructure. This Rider DE is important to the proposed projects because of the threefold increase power demand.

The increases in demand at each site will prompt ComEd system improvements at all operating locations. The total value of the power grid improvements driven by each location will be evaluated against ComEd's estimated distribution delivery revenue. If the cost of improvements exceeds estimated revenue, Pace may be required to submit a Rider DE deposit that gets reimbursed commensurate with the increase in power use for a maximum of 10 years. Pace will remain engaged with ComEd's Economic Development team for support in managing a potential Rider DE process.

Table 2: Power requirements by Division for a fully-electric fleet [1]

Division	Existing Power Service Capacity (kW)	Projected Need (kW) with Charge Management	Percent Increase
North	400	1,040	260%
Northwest Wheeling	4,000	3,510	--
River	665	2,340	352%
North Shore	532	1,330	250%
Southwest	532	1,560	293%
South	2,992	2,990	--
Fox Valley	1,064	3,510	330%

1. 800kWh battery capacity. Winter operating conditions with auxiliary heater.

West Division and Heritage Division were not evaluated because of recent midlife/construction and will be looked at in five years when this plan is updated based on transition progress.

There are no numbers for South Division because it is being designed as a hydrogen facility.

2.1 RESILIENCE

As a regional provider of transit bus service during emergencies, Pace requires that 70 percent of its fleet must be ready to provide emergency evacuation support to communities whenever needed. Pace's role as an emergency responder also can influence the zero-emissions transition. Unllike fleets that run on fuels like diesel, CNG, and FCEB that can be stored on site or distributed through stable networks, grid power is known to be "interruptible". In the event of an outage, ComEd prioritizes reestablishing service to customers with essential needs (e.g., first responders, hospitals, and pump stations) and Pace is working with ComEd to establish priority status within this framework.

To address this challenge, the design team explored photovoltaics (PV) and battery energy storage systems (BESS), but determined that they currently cannot meet Pace's resilience needs. BESS remain expensive. Current PV technology also would not generate the required power in a metropolitan region and climate like

Northeastern Illinois. Additionally, lithium-ion batteries in BESS are susceptible to fires, also known as "thermal runaway events". Other technologies such as Redox flow batteries offer more economical and safer ways to store electrical energy, and greater flexibility to tailor power and energy ratings for specific applications. A Redox flow battery is a fully rechargeable electrochemical energy storage device that converts chemical energy into electrical energy by pumping fluids through an ion-exchange membrane. While they have their benefits, Redox flow batteries do require large storage sites that are not available at Pace's operating divisions.

To ensure a resilient grid in times of power outages, Pace is pursuing secondary power feeds to facilities housing BEBs. These secondary feeds will either be off a separate circuit from a given substation or from a different substation than the main power source. To provide additional redundancy for backup power, current designs for facilities housing BEB fleets include two 1.5MW medium voltage (12,700 volt) generators. This arrangement would provide enough emergency power to charge 20 buses at 150kW each.

Under this plan, Pace would cover the cost of the secondary feeds, while an agreement with ComEd would cover the cost of the primary feeds. Under such agreement, Pace would be reimbursed for costs based on electrical usage over a specified period. At North Division, for example, the cost of the secondary circuit would be a one-time capital expense of about $700,000. By comparison, 1.5MW generators cost about $2 million each.

2.2 CHARGE EQUIPMENT

Two dominant charging systems currently exist in the market for transit buses: pedestal chargers that feed one to three buses at a time and DC-to-DC (direct current) containerized charging that can charge up to 40 buses.

Pedestal chargers work best for smaller deployments such as pilot programs of up to 20 BEBs. For larger BEB fleets, the typical plug-and-cable design of pedestal chargers limits the rate of energy that can be delivered to a vehicle. To power a larger fleet, many separate elements are needed, including transformers, electrical switchgear panels, and a network of

conduit to distribute the power to multiple charging cabinets throughout the bus storage area. Providing adequate space for these cabinets within the tight parking configuration of a typical bus garage can reduce a facility's storage capacity and present safety concerns. Additionally, one or two bus lanes likely may be affected when the cabinets need maintenance work. This charging approach also requires operations staff to manually connect the plug to each bus, as well as a cable management system to retract the cables after charging.

By comparison, the DC-to-DC containerized charging cabinets can be located more than 300 feet away from the connecting point to a bus. Although this method is relatively new for BEB charging, it has been used for more than a century to power electrified rail networks. These systems take medium voltage power (12,700 volts in this application) directly from the utility to the charger, eliminating a lot of electrical equipment that would take up space. DC-to-DC chargers also are modular in construction. If one of the 20 modules in a typical 3MW charger malfunctions, it can be easily replaced without affecting the functionality of the other 19 modules. This allows for centralized maintenance and the ability to connect directly to a medium voltage supply providing high charging capacity. Placing the containers outdoors, adjacent to the building, or on the roof, also will reduce the heat load to the building and free up space that, otherwise, would be dedicated to charger pedestals and their associated equipment. For these reasons, DC-to-DC containerized charging cabinets are recommended in the conceptual designs for Pace's garages.

Figure 2: Individual Charge Cabinet by Heliox

Figure 3: Containerized Charger and Substation by ABB — Hitachi

2.3 PANTOGRAPHS

Pantographs are retractable, scissor-like contact arms that connect to a vehicle to provide charging power. For rail systems, pantographs attach from the trainset roof and extend upward to the overhead lines. For bus charging, inverted pantographs are stationary and mounted to an overhead structure (shown in **Figure 4**).

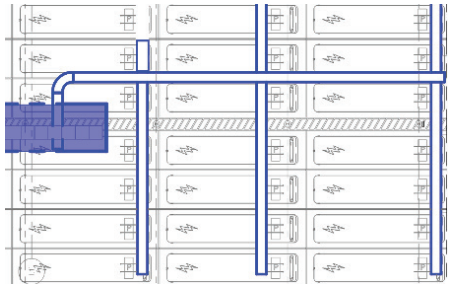
When using pantographs for charging, buses must park in a prescribed and precise location that can allow the pantographs to extend downwards and connect. Pantographs deploy automatically using near field communications, such as radio-frequency identification (RFID), and provide a failsafe connection between the charger and electric rails mounted on the roof of the bus. This charging method reduces vehicle weight, removes the need for a cable management system, and eliminates the need for an employee to manually connect the chargers required with plug-in options.

Pantograph charging systems specified for Pace's divisions would deliver charge rates of up to 150kW, the optimum rate to recharge the fleet overnight. While the containerized charging cabinet recommended for Pace installations can provide pantographs with up to 450kW output, accomplishing this greater charge rate requires upsized cabling between the charger and pantograph. This greater rate is useful for midday layover quick charging of buses that return to the garage or on-route charging. Cables to provide this charge rate can be specified for a minimal number of pantographs, typically around five, or planned for future replacement.

Because the design of fleets and lengths of vehicles can vary over time, an adjustable overhead cable tray system is recommended for distributing power and data from containerized chargers. Similarly, an adjustable rail system, such as Unistrut, is typically used for attaching pantographs to the roof. Both systems can be relocated with minimal effort and adapted to fit different bus lengths. Given factors such as charging rate, automated operation, and reduced maintenance, pantographs are recommended and are incorporated into the conceptual designs for Pace's bus storage areas. Plug-in chargers also are incorporated into designs, but only to supply low power to run diagnostics for vehicles in the maintenance areas.

Figure 4: Inverted Pantograph by Schunk

Figure 5: Typical charger and cable tray serving 20 buses



2.4 CHARGE MANAGEMENT

Charge management systems (CMS) can dynamically control the rate and distribution of fleet charging. The supporting software systems can optimize charging by facilitating parallel or sequential charging.

Parallel charging simultaneously powers all connected buses simultaneously at the same rate, although typically at lower power levels for each bus. Sequential charging allows selected buses to receive greater power for a faster charging time at the expense of reduced power to other buses. The software helps reduce peak power use by reducing charging at times of the day when demand and utility rates are highest, typically late afternoon and early evening. The software also can prioritize distribution to consistently ensure the desired 70 percent fleet service readiness standard (as discussed in **Section 2.1**). Charge management also can reduce the amount of power consumption, especially during peak demand periods. Utilities typically set their rate structure for a given period (the amount a consumer pays per kilowatt hour) at that maximum rate. The power requirements, as shown in **Table 2** previously, include the projected kW needed with charge management to reduce the peak demand. CMS solutions require the installation of an onboard telematics device. As a CMS solution with telematics is selected, the technical specifications for all future bus procurements will reflect this component. As such, the selection and procurement of a CMS solution is a key activity. The CMS solution will require collection of information directly from the BEB chargers to transmit the data to either an on-site server or to a cloud-based server. These communication and server requirements are included in the design documents for planned facility upgrades.

3 Facility Modifications

To meet Pace's goal of transitioning to a 100 percent ZEB fleet by 2040, significant facility modernizations and expansions are required, as well acquisition of new ZEB vehicles. The facility modifications will accommodate Pace's growing fleet and staff.

3.1 ASSESSMENTS

To establish a baseline of existing conditions, a team of architects, and civil, structural, mechanical, plumbing, fire protection, electrical, and industrial engineers conducted comprehensive assessments throughout spring 2022 at the following divisions:

North Division	**March 17, 2022**
River Division	**March 18, 2022**
Northwest Wheeling Division	**April 13, 2022**
North Shore Division	**April 14, 2022**
Southwest Division	**April 15, 2022**
Fox Valley Division	**May 4, 2022**
South Division	**May 5, 2022**

** West and Heritage Divisions are being reviewed in five years*

The assessments revealed that divisions require renovations to maintain a state of good repair, increase vehicle storage, and support the significant capital investments required to introduce BEB infrastructure. Areas in need of replacement and upgrades include failing pavement, roofing, HVAC systems, repair bay equipment, and structural systems. Except for pavement, the identified upgrades are related — directly and indirectly — to the introduction of BEBs.

The assessments identified deferred maintenance needs that could align with the proposed ZEB facility upgrades to minimize construction-related disruptions to Pace's operations. For example, scheduled roofing replacements can be coordinated with BEB upgrades such as charging and roofing equipment to reduce schedules and cost. To minimize future service disruptions and future-proof facilities for the zero-emissions transition, secondary infrastructure such as cable trays, overhead distribution conduit, and pantograph supporting rails also can be installed within the scope of the initial construction and reduce the complexity of future construction phases.

Individual facility assessment reports are included in **Appendix A**. Preliminary designs for each facility are included in **Appendix E**.

3.2 FACILITY CAPACITY

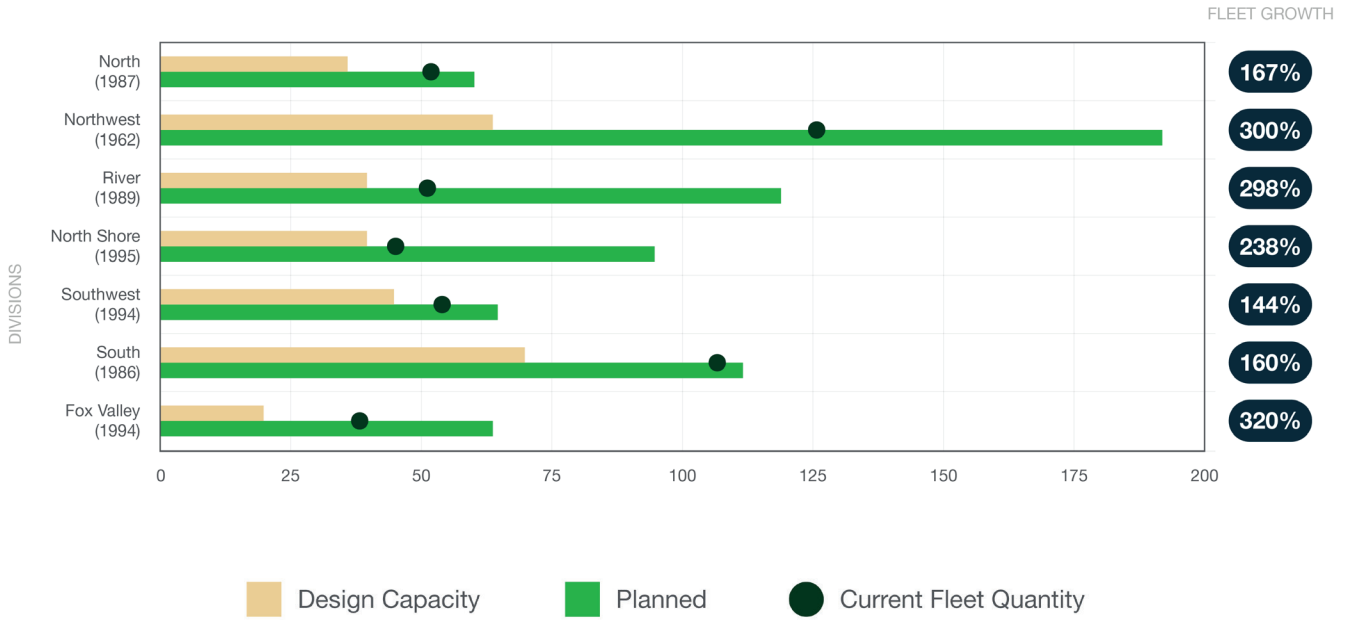
Proposed changes must maximize the bus storage capacity at all facilities. Most of Pace's divisions operate over their original design capacity. For example, North Division was built to accommodate 36 vehicles, but currently houses a fleet of 53 vehicles (**Figure 6**). Because BEBs each need a dedicated parking spot to charge, the creative solutions that Pace has employed in the past to house a fleet greater than the facility design capacity will no longer be viable.

Table 3 shows the useful replacement life of various facility attributes. The average age of the nine divisions is 32 years, which exceeds the life of most of these components.

Table 3: Facility Components: Useful Replacement Life

Paving	**20 years**
Foundation and Structural System	**75 years**
Exterior Wall Finish	**50 years**
Roofing	**15 - 30 years**
Mechanical Equipment (HVAC)	**30 years**
Shop Equipment	**10 - 25 years**

Figure 6: Age and Growth of Divisions



**Northwest Design Capacity quantity is for the Des Plaines facility and Planned quantity is for the Wheeling facility.*

To develop facility expansion plans, Pace is accounting for current and future vehicle storage requirements to maximize capacity and align with future service goals. Unless specifically noted, storage capacity numbers are presented to reflect 40-foot vehicles. The storage of other vehicles can be roughly determined as a product of the actual vehicle length compared to the 40-foot transit bus (e.g., a garage storing 90, 40-foot buses would hold approximately 60, 60-foot articulated buses or 144, 25-foot paratransit vans). The designs also have considered aisle length and clearance between vehicles.

Due to increased bus storage, expansions to the administrative, maintenance, and driver welfare areas are proposed to address growing staff counts and provide standard modern amenities. Additional training rooms are needed to train staff on the different operating dynamics and maintenance procedures of BEBs. The opportunity to modernize staff spaces as part of the BEB renovations also can help improve the work environment and make Pace an attractive option for job seekers interested in emerging career opportunities and the new electric vehicle market.

3.3 BUILDING SYSTEMS

The proposed facility design concepts account for the increased fleet quantity. The concepts meet standard industry ratios of one repair bay for every 10 to 15 buses, two drivers for each bus, and other associated levels of staffing.

Many of the critical components that require maintenance on BEBs are housed on the vehicle roof. Under these concepts, repair areas in each division will be outfitted with fall protection systems to ensure worker safety. Cranes are needed to help remove and replace roof-mounted equipment. By comparison, as the diesel fleet is retired over time, the need for in-ground lifts will be reduced. While most Pace divisions have retired their original in-ground lifts, some still need to be fully decommissioned or replaced to meet Pace's standard of 25 to 33 percent of repair bays equipped with Pace's standard lift (Sterlit-Koni ECO recessed scissor lift, as installed at Heritage Division). Repair bays will also require low-power chargers to supply BEBs with sufficient power to run system diagnostics during maintenance activities. Several of the facilities have inspection and maintenance pits that will become obsolete over time. As the fleet transition continues these pits must be cleaned and filled in.

The addition of medium voltage electrical service from ComEd to meet BEB fleet charging needs requires coordination with Pace Operations staff. Construction of the underground duct banks for new conduits from the ComEd meter to the chargers will disrupt operations, but also presents an opportunity to repair and replace pavement that has been damaged over the years. Where building additions are required to accommodate an expanded bus fleet, the capacity of existing stormwater management systems will need to be evaluated. These systems may need to increase pond volumes or introduce new underground detention systems.

The fire protection systems will need to be enhanced. As part of the project development, Pace continues to collaborate and coordinate with local fire departments and permitting agencies on the needed enhancements required for the fire protection systems. The lithium-ion batteries

that power BEBs have the potential for thermal events when the battery arrays heat up and progressively deteriorate in a manner that can lead to emergencies. These types of fires are virtually unextinguishable since the degrading batteries supply the heat, fuel, and oxygen that contribute to combustion. To mitigate this risk, the current design, referred to as "surround and drown", increases the flow of water from the building fire sprinkler system. Because current building and fire codes do not address fire suppression for electric vehicles, recommendations are based on highly specialized and computer intensive modeling. The modeling determines the required amount of water flow needed and considers the spacing between buses to keep the fire from spreading. Going forward, a zero-emissions transition needs to involve input from local fire officials who can help develop a methodology for this type of fire suppression and inform the designs for sprinkler system upgrades.

The proposed designs address this issue in multiple ways. For example, a standpipe system in bus storage areas will be provided to supply increased water for fire departments responding to an emergency. Fire flow tests at each site were performed to determine if additional measures, such as on-site water storage tanks, are required to provide sufficient water pressure.

Fire risk also can be managed through fire prevention. For example, buses are equipped with an integrated battery safety and thermal monitoring system that can detect an issue, activate an audible alarm, and power off the bus. Charge management systems monitor the status of charging equipment and activate alarms, power off charging, and send a supervisory signal to the building's fire alarm control panel before a vehicle ignites. BEB battery packs are also increasingly equipped with cell-level passive propagation resistance technology that isolates defective battery cells from the rest of the battery pack to prevent thermal runaway events. All these active and preventative design considerations will help minimize the potential for property damage and increase safety for building occupants.

3.4 ZEB IMPLEMENTATION

Pace periodically reviews fleet assignments throughout the system to ensure the highest quality of service. One component of these reviews assesses the average age of the bus fleet within each division and makes sure equitable service and passenger amenities are equitably distributed throughout Pace's service area. Based on this periodic assessment, buses are transferred between divisions to address any inequities. In addition to balancing the fleet age, this transfer also allows Pace to balance out average fleet mileage and ensure maximum return on investment of mileage-based bus fleet warranties.

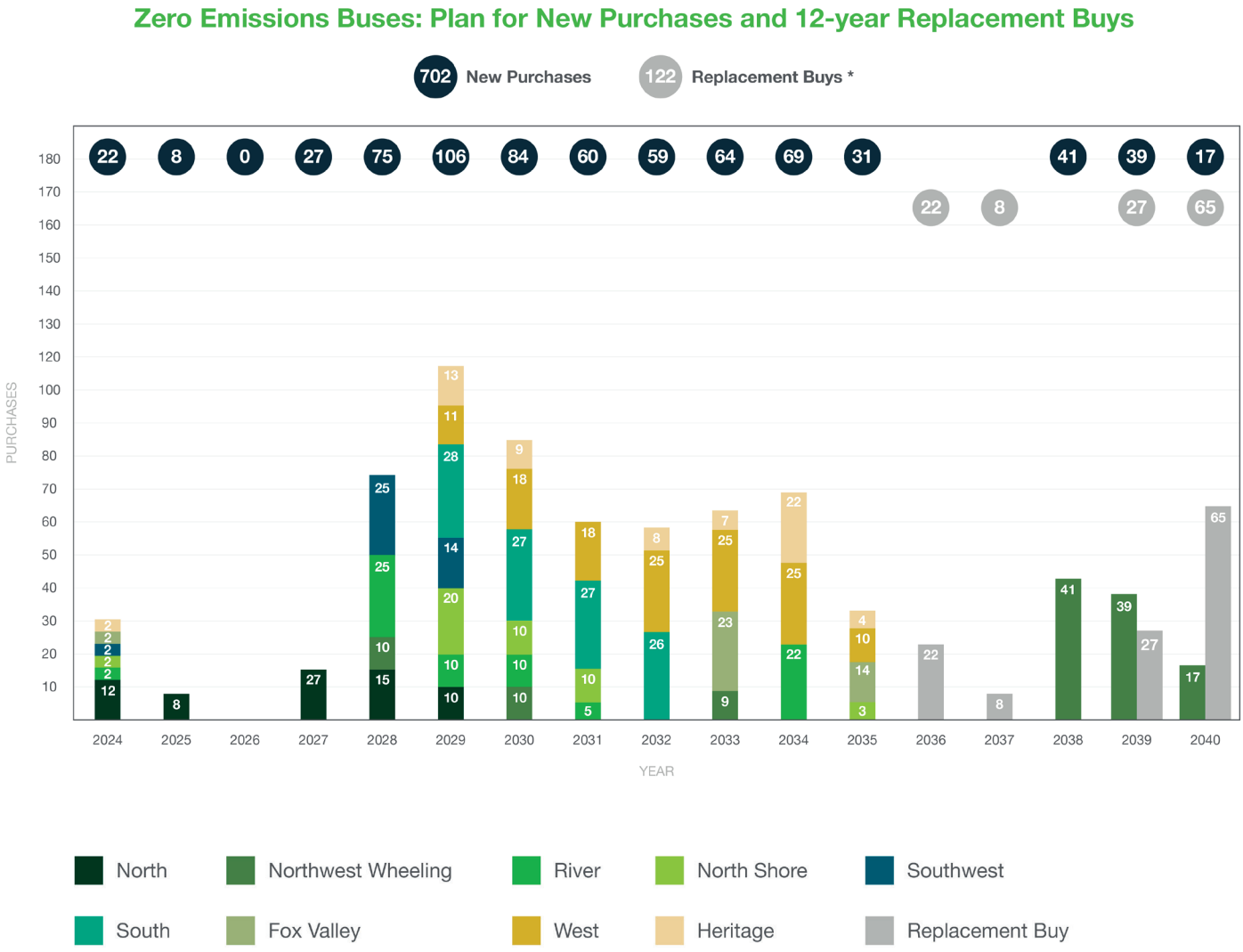
The transition to a zero-emission fleet will require revisions to the Pace fleet balancing program. BEB and FCEB buses require specific infrastructure modifications at each division and installation of new equipment. Divisions that are transitioned to these new systems will have newer fleets. Pace is committed to prioritizing communities that rely most on Pace's services and ensuring they receive the most benefit of the zero-emissions transportation services and fleet.

The following graph (**Figure 7**) represents the annual fleet replacement plan based on Pace's current fleet assignments. This plan reflects Pace's goal of achieving a 100-percent, zero-emissions fixed-route fleet by 2040. This plan will require annual updates as the fleet size changes and service and schedule modifications are implemented.

In this graph, Pace's divisions are listed in the presumed order of their transition to a zero-emissions facility. The number of non-ZEBs that meet the criteria for retirement at each division are shown by year and are based on the 12-year Useful Life Benchmark (ULB) for bus replacement. These non-ZEBs are presumed to be replaced with ZEBs for that year. The annual totals are shown at the bottom of the chart.

As the fleet continues to transition, earlier ZEB purchases will have to be replaced with new ZEBs when their lifecycle is complete. These are coded as Replacement Buy, or RB quantities, and are not included in the yearly transition quantities. However, such RB volumes would need to be accounted for in the annual capital expenditure planning for those years.

Figure 7: Fleet Transition Timeline



**Based on 12-year Useful Life Benchmark (ULB) replacement timing estimates, Pace also expects to purchase replacement Zero-Emissions Buses between 2035 and 2040.*

The following sections summarize the BEB implementation plan for each division.

3.4.1 NORTH DIVISION

The facility modifications to support an all electric fleet by 2027 will occur in two phases. Phase 1, planned for construction in 2024, will support an initial fleet of 12 BEBs. Construction of Phase 2 will begin in 2025 and will include improvements for the indoor storage and charging of 60 BEBs.

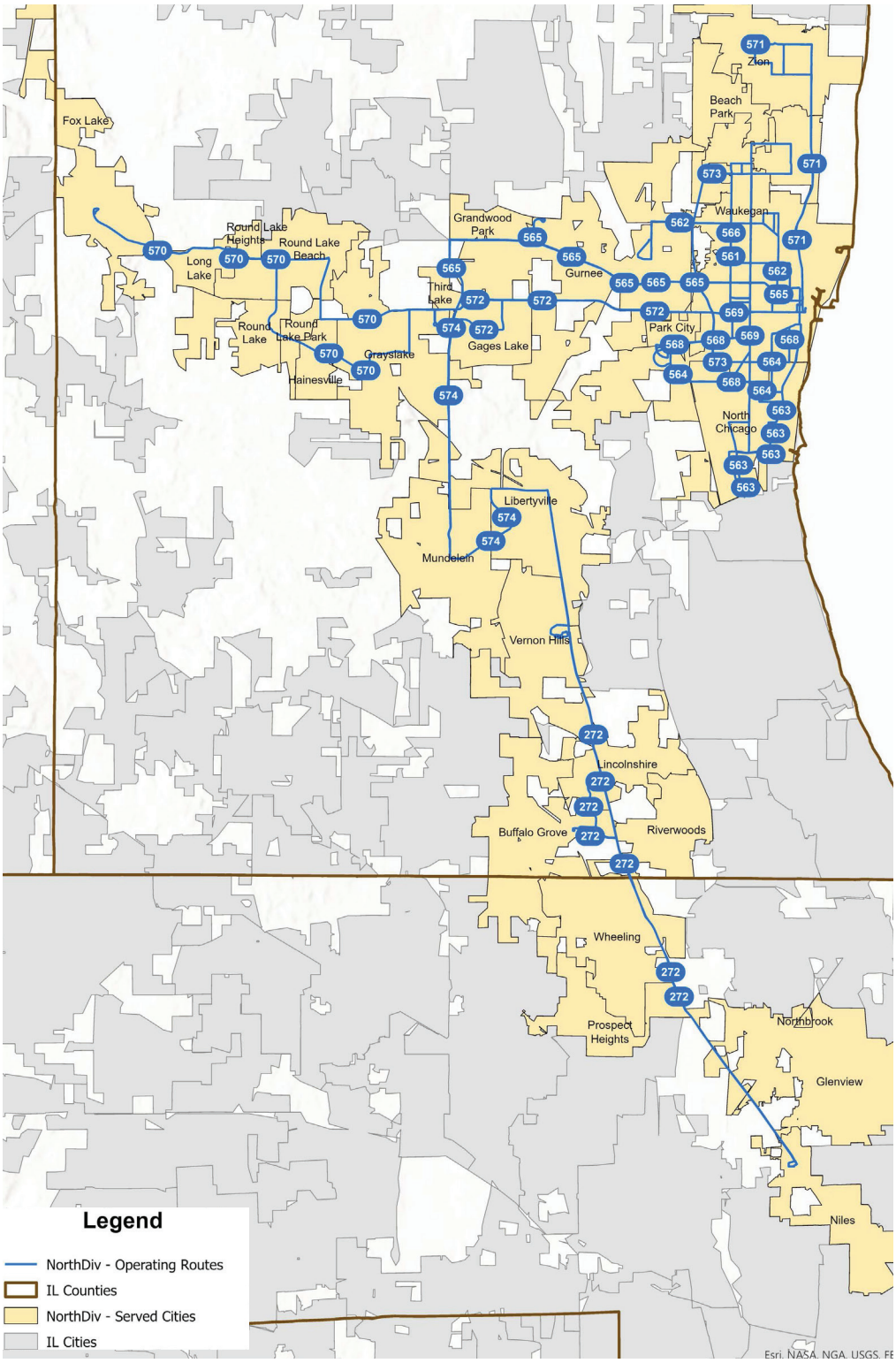
Phase 1 improvements will include 10 plug-in pedestal chargers under a canopy and two additional high-powered pantograph chargers. Phase 1 improvements are scheduled to be operational by the third quarter of 2024. This initial fleet and charging equipment will enable Pace to train drivers and mechanics in the dynamics of BEB systems prior to the larger fleet conversion following Phase 2 construction.

Phase 2 is more complex, increasing the indoor fleet storage capacity from 36 to 60 buses, and expanding maintenance, administrative, and driver welfare areas to accommodate additional staff and increase bus capacity. With the completion of Phase 2, Pace will be able to evaluate the performance of BEBs under full-scale operating conditions.

Phase 2 improvements to the bus storage area include the installation of 60 overhead pantograph chargers and the necessary structural modifications to support the equipment's weight. Additional training and classroom space is also planned.

Based on Pace's Fleet Replacement Plan, North Division's fleet will be fully converted to BEBs by 2027. Facility improvement plans are progressing to meet the vehicle replacement schedules.

Map of North Division Routes Operated by Pace



Communities Served

- Beach Park
- Buffalo Grove
- Fox Lake
- Gages Lake
- Glenview
- Grandwood Park
- Grayslake
- Gurnee
- Hainesville
- Libertyville
- Lincolnshire
- Long Lake
- Mundelein
- Niles
- North Chicago
- Northbrook
- Park City
- Prospect Heights
- Riverwoods
- Round Lake
- Round Lake Beach
- Round Lake Heights
- Round Lake Park
- Third Lake
- Vernon Hills
- Waukegan
- Wheeling
- Zion

North Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

North Division has been well-maintained over the years, but requires upgrades to maintain a state of good repair and accommodate BEBs.

The original structural roof framing was designed to support the weight of a stone ballast, which weighs 12-25 pounds per square foot. A roofing project in 2004 replaced the stone ballast with lighter roofing materials, freeing capacity in the original structural framing for additional loads.

The proposed BEB pantographs and cable trays will be suspended from the roof structure above the bus storage area. Since most of the roof structure is in good condition, the additional loads from the new equipment can be supported with localized strengthening of structural members.

Bus storage, maintenance, and administrative spaces are currently undersized.

FACILITY MODIFICATIONS

North Division ZEB facility improvements will occur in two phases.

Phase 1 improvements support the 12 BEBs that are scheduled to be delivered in 2024.
Improvements will include:

- Large outdoor concrete pad for bus parking
- Installation of 10 pedestal chargers with plug-in connections
- Installation of 2 high-rate overhead pantograph chargers
- Installation of 2, 1440Kw bus charging units
- Electrical upgrades and equipment installation for bus charging
- Installation of additional outdoor fire hydrants
- Bus canopy over pedestal charger area with optional solar panels
- Upgrades to the storm water management system
- Site work

Phase 2 improvements will accommodate a BEB fleet of 60 vehicles indoors.
Improvements will include:

- 13,400-square-foot addition to bus storage area (requires demolition of north wall and construction of 7,650 feet of exterior wall)
- Removal and replacement of selective areas of roof framing
- Upgrades to electrical system to support medium voltage bus charging
- Procurement and installation of bus chargers, pantograph dispensers
- Reconfiguration and expansion of administrative, maintenance, and employee welfare spaces
- Removal and replacements of lifts in repair area
- Fire suppression upgrades
- ADA upgrades

UTILITIES

For Phase 1, ComEd will extend medium voltage (12kV) service to the site property up to and including equipment at the point of connection to serve new charging equipment. Existing ComEd service (480 volts) will remain in place to feed all non-BEB charging building loads.

ComEd completed off-site construction for Phase 1 upgraded electrical services in November 2023.

All necessary line extensions (Phases 1 and 2) are subject to ComEd's Rider Agreement.

ComEd is planning a 2-circuit medium voltage service for the facility based on the charging needs and PEER analysis for a fully BEB fleet.

A secondary power feed for redundancy is also being designed and requires automated throw over equipment (ATO) that is subject to monthly rental included in the site utility billing.

ZONING & NEPA COMPLIANCE

Phase 2 improvements require a modification to the existing Conditional Use Permit from the City of Waukegan.

Phase 2 required environmental clearance under the National Environmental Protection Act (NEPA). FTA Region 5 approved on April 26, 2023.

CONSTRUCTABILITY

Phase 1 can be constructed with minimal impact to transit operations through coordination between the contractor and Pace Operations staff.

An extension of the electrical conduit along the west driveway for charging infrastructure, which will serve both phases of the project, will be installed during Phase 1 to minimize construction impacts.

Phase 2 work significantly impacts bus storage and staff areas. Phasing construction in these areas to maintain operations would be costly and would considerably extend the construction schedule. Therefore, a temporary facility for indoor bus storage and dispatch will be required for the duration of construction. The planned modifications to the shop area can be achieved through phasing and can remain operational during construction for daily servicing of vehicles. Administrative offices will be relocated.

3.4.2 NORTHWEST WHEELING DIVISION

The new Northwest Wheeling Division is a priority project for Pace. Routes serving northwest suburban communities currently operate out of Pace's Northwest Division in Des Plaines.

The 82,700-square-foot facility was constructed in 1962 to accommodate 64 vehicles and now houses approximately 126 buses in indoor and outdoor storage areas. In 2018, Pace purchased a 400,000-square-foot printing and warehouse facility in Wheeling to convert it to an operating division capable of accommodating up to 192 fixed-route vehicles and replace the Des Plaines location.

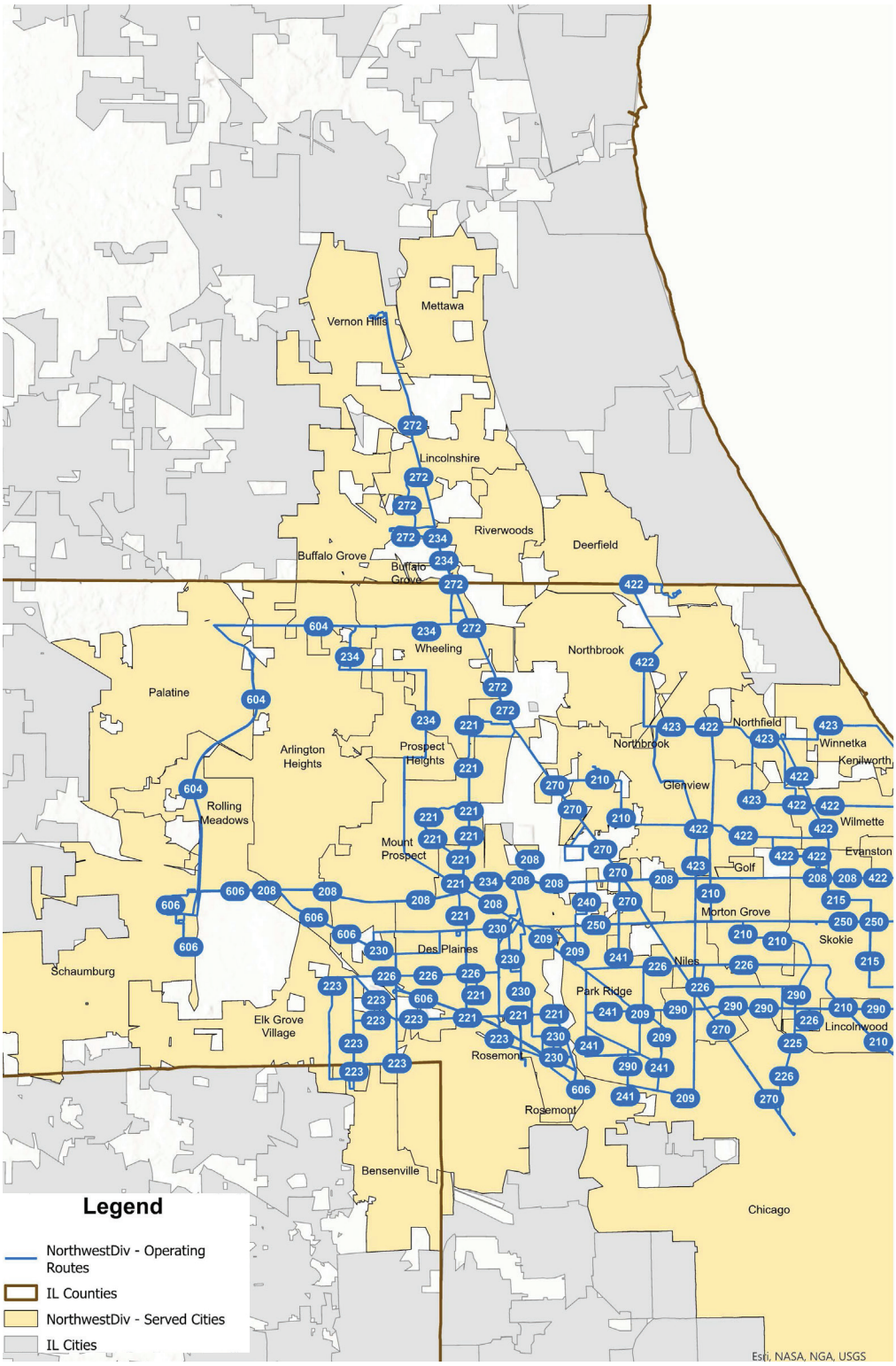
The Wheeling facility requires ongoing maintenance for heating systems, fire safety equipment, and other water systems. However, as an unoccupied facility, construction activities can occur without interrupting daily operations, making it an excellent opportunity to house a large fleet and to accelerate the ZEB fleet conversion.

Due to long vehicle blocks, a mixed fleet of CNG and BEBs are required to maintain existing service levels in the short term. Facility modifications will include a CNG fueling facility and charging equipment to support 20 BEBs upon opening. Additionally, provisions for the installation of future charging infrastructure will be made. As CNG vehicles reach the end of their useful life, this enables Pace to add more ZEBs to the fleet without requiring major building renovations.

Upon completion, Northwest Wheeling will be Pace's largest operating division and will support both fixed-route bus and vanpool services. The facility will enable Pace to expand transit services in the surrounding communities while maintaining services currently operated out of Des Plaines.

Design is currently developed to 30 percent and the project will be constructed via progressive design-build contract, as described in **Section 5**.

Map of Northwest Wheeling Division Routes Operated by Pace



Communities Served

- Arlington Heights
- Bensenville
- Buffalo Grove
- Chicago
- Deerfield
- Des Plaines
- Elk Grove Village
- Evanston
- Glenview
- Golf
- Kenilworth
- Lincolnshire
- Lincolnwood
- Mettawa
- Morton Grove
- Mount Prospect
- Niles
- Northbrook
- Northfield
- Palatine
- Park Ridge
- Prospect Heights
- Riverwoods
- Rolling Meadows
- Rosemont
- Schaumburg
- Skokie
- Vernon Hills
- Wheeling
- Wilmette
- Winnetka

Northwest Wheeling Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

Purchased by Pace in 2018 to replace the Northwest Des Plaines facility, the existing structure in Wheeling is a former printing and warehousing facility that Pace plans to convert to a bus garage capable of housing a mixed fleet of CNG and BEB vehicles.

Heating and plumbing systems require constant attention to maintain their operation and integrity. Deterioration of internal finishes has made some of the building unsafe for occupancy. Initiating the facility conversion must be prioritized to limit further deterioration and minimize maintenance costs.

Remediation of hazardous materials has already occurred. However, since this building is being repurposed, schedule and cost estimates take into consideration that there could be additional unknown hazardous material remediation.

FACILITY MODIFICATIONS

30 percent of designs are complete. Upon opening, the facility will house and maintain a mixed fleet of approximately 96 CNG and 20 BEB, 40-foot vehicles with the capacity to house up to 192 ZEBs. The facility will also accommodate vanpool storage, charging, and administration, as well as Pace's print shop.

All utility services, equipment, and building systems are sized for this ultimate capacity. As the BEB fleet expands, additional charging equipment and cabling will be installed and connected to electrical wireways. Switchgear provided in the initial construction will minimize future impacts to operations.

The CNG fueling equipment that is being installed also has the potential to be replaced to support hydrogen FCEBs, if desired.

Other Improvements include:

- Removal of the concrete slab in the future bus storage area
- Modification to the structural grid to accommodate bus movements
- Removal of existing roof framing and deck, replacement of portions in bus storage area
- Installation of skylights, replacement of roof membrane in administrative and vanpool office areas
- New HVAC equipment and fire suppression system
- Southern portion of building converted into servicing and maintenance areas
- Installation of 17 maintenance bays, 4 with in-ground lifts and 13 with mobile column lifts
- Installation of cranes and fall protection system to accommodate the maintenance of vehicle charging equipment mounted on bus roofs
- Installation of outdoor CNG fueling facility
- Installation of backup power generators for bus charging
- Improvements to stormwater management systems
- Increased onsite parking and vehicle chargers for employees
- Upgrades to onsite lighting, landscaping, and other site work

UTILITIES

Pace is working with ComEd to provide the power required to charge an initial fleet of 20 BEBs currently programmed for the division.

As the fleet continues to transition, a secondary power feed for redundancy is planned that requires automated throw over equipment (ATO) that is subject to monthly rental included in the site utility billing. Plans also call for natural gas fired generators to charge up to 20 buses in the unlikely event of an outage on both the primary and secondary power feeds.

In 2022, to support the originally planned CNG facility, ComEd completed a distribution design to provide service for this site. Electrical loads not related to BEB charging will be fed by three existing low-voltage electrical services. ComEd has provided high-level feedback that the proposed BEB load for this site can be served from nearby medium voltage facilities, and an analysis is being conducted to see if there is existing excess capacity.

The new medium voltage service will enter from the north side with ComEd metering equipment positioned near the property line. The design of this proposed service should commence approximately 12 months before the start of any site construction.

Nicor, the local natural gas utility, has recently reconfigured the high pressure main at the northwest corner of Old Willow Road and Wolf Road, putting in a new high pressure reducing station.

Modifications will also be made to the water service for both domestic and fire suppression uses. Fire flow tests conducted in May 2023 indicated there is sufficient capacity and water pressure.

ZONING & NEPA COMPLIANCE

The Village of Wheeling provided approval of Ordinance No. 5221, granting special use site plan approval for a ground transportation service, on November 19, 2018, allowing Pace to move forward with the development of the CNG maintenance facility. Alterations to the CNG design to accommodate BEBs and an increase to the bus storage capacity require Pace to amend its previously approved design and apply to modify the ordinance prior to finalizing design.

Pace needs relief from federal agencies for the conversion of Northwest Wheeling Division. Pace originally acquired this facility to convert to CNG operations prior to shifting to planning for BEB operations. The facility was purchased using local money with the intent to make proposed improvements using state and local funding, therefore the federal environmental review process (NEPA) was not completed for the site. However, with the inclusion of ZEB infrastructure, there are significant gaps in project funding. Pace is currently exploring ways to complete NEPA documentation making this project eligible for additional federal funding.

CONSTRUCTABILITY

No phasing is required since the existing building will be vacant during construction. To accommodate for planned expansions of the BEB fleet, wireways will be installed during the initial construction to streamline future installation of additional charging equipment and cabling to minimize disruptions to operations.

3.4.3 RIVER DIVISION

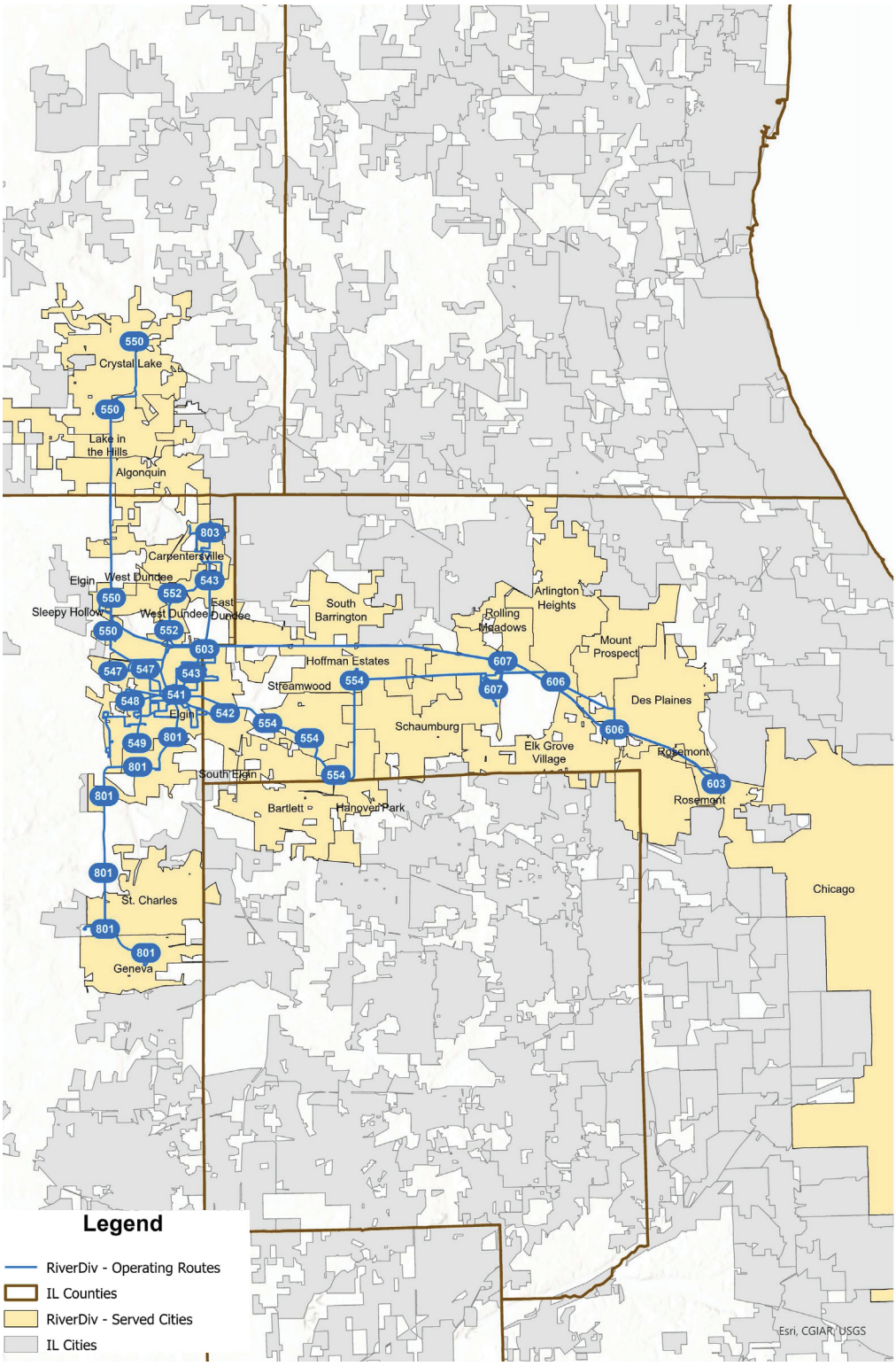
River Division in Elgin was constructed in 1989 and presently houses 29, 30-foot and 9, 40-foot buses and 17 paratransit vehicles. As with other divisions, the facility has been well maintained, but is scheduled for midlife renovations to maintain a state of good repair. Additionally, due to insufficient space at the current facility, Pace has been leasing garage space in East Dundee since 2018, when 25 vehicles were added to the fleet to provide express service on I-90.

To save on annual leasing costs and to provide room for future growth, Pace plans to expand the capacity of the existing River Division by utilizing newly acquired property immediately south of the existing site. This project will more than double the garage's current capacity while providing the necessary space for future service expansions.

The River Division improvements can be constructed in phases to maintain operations during the expansion of the bus storage, maintenance, administrative, and driver welfare areas. Additional improvements include increased staff and visitor parking and modifications to the stormwater management system.

The design has been developed to approximately 30 percent and will be delivered using the design-bid-build project delivery method. Based on Pace's Fleet Replacement Plan, River Division will have a mixed fleet of diesel and BEBs upon opening.

Map of River Division Routes Operated by Pace



Communities Served

- Algonquin
- Arlington Heights
- Bartlett
- Carpentersville
- Chicago
- Crystal Lake
- Des Plaines
- East Dundee
- Elgin
- Elk Grove Village
- Geneva
- Hanover Park
- Hoffman Estates
- Lake in the Hills
- Mount Prospect
- Rolling Meadows
- Rosemont
- Schaumburg
- Sleepy Hollow
- South Barrington
- South Elgin
- St. Charles
- Streamwood
- West Dundee

River Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

River Division has been well maintained over the years but requires upgrades to maintain a state of good repair, expand capacity, modernize repair areas, and accommodate BEBs.

The administrative and welfare areas of the building are in good condition but will need to be expanded given the increased number of vehicles that the facility will house.

The existing structural roof framing is not able to support additional loads from the pantograph chargers, electrical cables, cable trays, PV panels, HVAC, and fire suppression systems.

The fire suppression system, while in good working order for existing operations, will need to be upgraded for a BEB fleet.

The electrical system is in good condition but will have to be upsized based upon the proposed modifications for vehicle charging.

FACILITY MODIFICATIONS

30 percent designs are complete to update, expand, and make accommodations for BEBs at River Division. Upon opening, the facility will house and maintain a mixed fleet of approximately 50 diesel and 20 BEB, 40-foot and 30-foot vehicles. The facility will also store and maintain a fleet of 35 paratransit vehicles and will accommodate charging of this fleet.

Six bays will be added to the Repair Area for maintenance of the increased bus fleet. The added structural loads and the column clearance and space requirements of the new repair bays informed the decision to provide a new roof with all new structural components.

This division will ultimately be able to house 119, 40-foot BEBs under pantographs. The number of bays in the shop will increase to accommodate the expanded fleet.

Other Improvements include:

- Upgrades to stormwater management system
- Pavement replacement
- Demolition of structures and regrading on acquired property
- Expansion of employee parking lot and installation of car chargers
- Exterior lighting and landscaping improvements
- Enhancements to fire protection systems
- Reconfiguration and expansion of maintenance and repair areas
- New loading dock
- Expansion of administrative and employee welfare areas
- Expansion of bus storage area
- Replacement and strengthening of roof structure
- Electrical upgrades and installation of charging infrastructure

UTILITIES

ComEd has reviewed the schematic design for this division and has identified potential source locations to extend facilities to the site. The off-property scope of work for ComEd has not been fully determined. The estimated cost will be subject to review for application of the Rider DE tariff. Provisions for a secondary feed will be coordinated with ComEd.

Upgrades will be required to the natural gas system to increase capacity for emergency generators. The fire suppression system needs to be evaluated to determine its capacity based on future fire flow testing.

ZONING & NEPA COMPLIANCE

There are no known zoning concerns for the development of this property.

Similar to Northwest Wheeling Division, Pace needs relief from federal agencies for the conversion of River Division. The adjacent property was purchased with local money and originally acquired prior to Pace shifting to planning for BEB operations.

CONSTRUCTABILITY

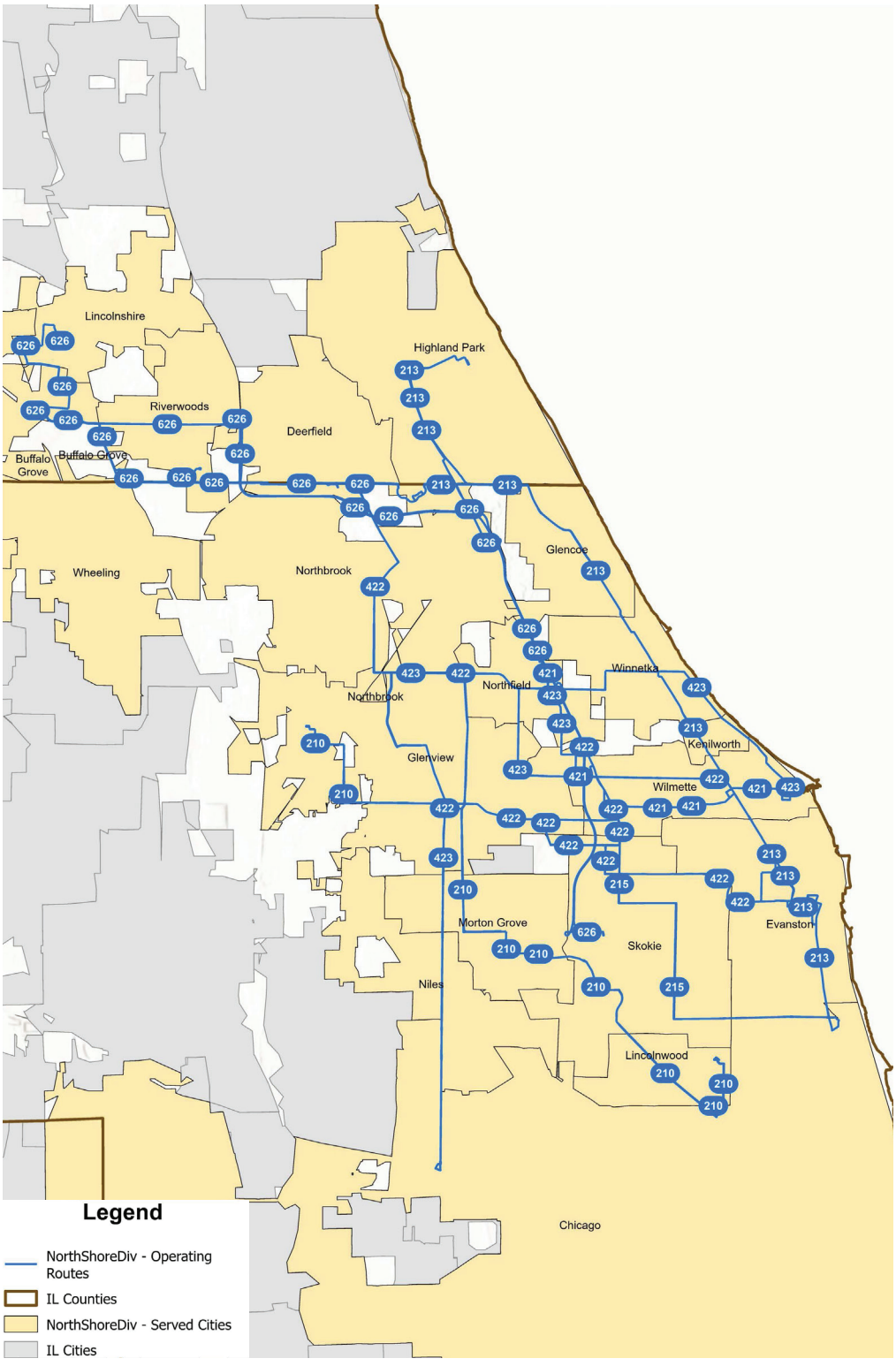
Through heavy construction phasing, this division will be almost entirely rebuilt. Bus maintenance operations and storage will continue throughout construction. Close coordination between Pace Operations staff and the contractor will be the key to the timely delivery of this project. The extensive remodel anticipated for the administrative and welfare areas of the building will require a temporary modular trailer complex to be set up in the west employee parking lot.

3.4.4 NORTH SHORE DIVISION

North Shore Division in Evanston was constructed in 1995. The facility has designated interior parking spaces for 40, 40-foot transit buses. Currently the garage houses 3, 30-foot buses and 43, 40-foot buses. The facility has been well maintained but is due for midlife improvements to maintain a state of good repair and to increase capacity for planned service expansions. Conceptual designs propose improvements that increase bus storage capacity to 95 and provide accommodations for BEB charging equipment.

North Shore and Southwest Divisions were built using the same building plan, therefore planned improvements at the garages are similar, but a larger site at North Shore permits greater expansion as Pace looks to increase transit service over time. This facility can be modified to support BEBs prior to increasing the fleet capacity. The proposed modifications to the administration and driver welfare areas may require relocation of staff, though this may be avoided with appropriate phasing.

Map of North Shore Division Routes Operated by Pace



Communities Served

- Buffalo Grove
- Chicago
- Deerfield
- Evanston
- Glencoe
- Highland Park
- Kenilworth
- Lincolnshire
- Lincolnwood
- Morton Grove
- Niles
- Northbrook
- Northfield
- Riverwoods
- Skokie
- Wheeling
- Wilmette
- Winnetka

North Shore Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

North Shore Division is a pre-engineered building that was built with a proprietary and nonstandard framing system to economize on materials and cost. Preliminary calculations show that the roof framing can handle the additional loads associated with BEB implementation, but more detailed study is required for final design. Pace currently owns additional property adjacent to the existing garage facility to accommodate expansion.

FACILITY MODIFICATIONS

10 percent designs have been developed to update, expand, and make accommodations for BEBs at North Shore Division. This division will ultimately be able to house 95, 40-foot BEBs under pantographs.

Other Improvements include:

- Expansion of bus storage area
- Expansion of the bus repair area
- New repair bays
- Removal and replacement of lifts
- Increased parts storage
- New loading dock
- Roof modifications for localized HVAC equipment loads
- Expansion of administrative and employee welfare areas
- Enhancements to fire protection systems
- Electrical upgrades and installation of charging infrastructure
- Upgrades to stormwater management system
- Expansion of employee and guest parking and installation of car chargers

UTILITIES

ComEd will be engaged in design development of an off-property power distribution extension to serve the capacity required to operate full BEB charging facilities. ComEd's design will extend medium voltage (12kV) service to the site property, up to and including equipment at the point of connection to Pace BEB charging equipment. Provisions for a secondary feed will be coordinated with ComEd.

The existing ComEd service (480 volts) will remain in place to feed all non-BEB charging building loads.

Modifications will be required to the stormwater management system as the new addition and parking areas will create more impervious area. The new detention system will be installed below the new parking area.

The existing natural gas service will need to be reevaluated to serve the demand load from 2 1.5MW generators associated with BEB charging resiliency.

Fire flow test should be conducted as the design is advanced to identify any limitations in serving the increased hazard groups for sprinkler systems in the bus repair and bus storage areas.

ZONING & NEPA COMPLIANCE

North Shore Division will require NEPA approval which, based upon continuation of the current transit use, should be a Categorical Exclusion.

CONSTRUCTABILITY

North Shore Division will be constructed in three phases. Phase 1 and Phase 3 can be constructed with the facility remaining operational. Phase 2 requires temporary trailers to accommodate administrative employees and dispatch. Charging infrastructure will be installed in accordance with the BEB implementation plan.

3.4.5 SOUTHWEST DIVISION

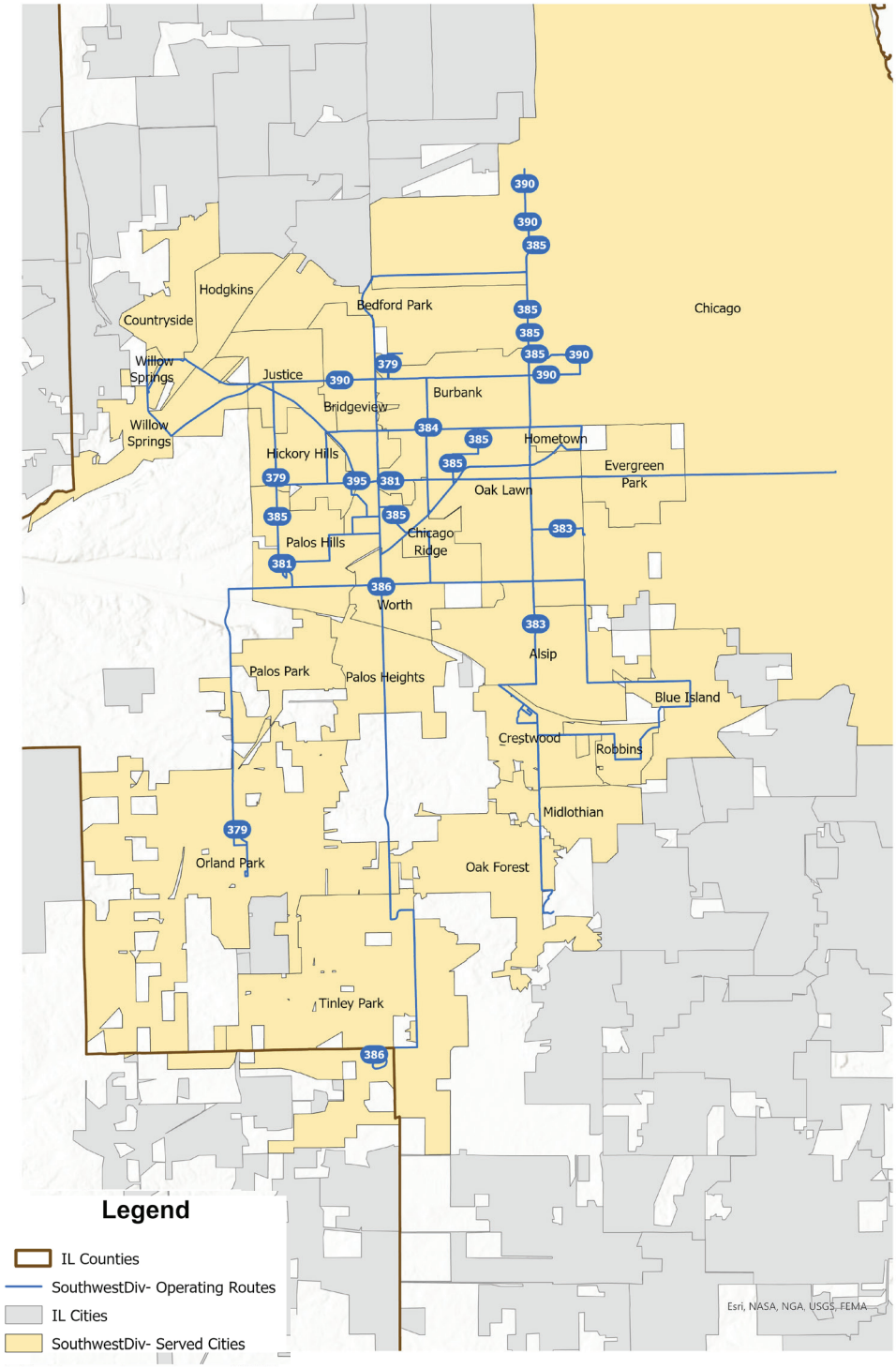
Southwest Division in Bridgeview was constructed in 1994 and currently has an assigned fleet of 18, 30-foot and 38, 40-foot transit buses with designated interior parking for 40 vehicles. As with other divisions, the facility has been well maintained, but is due for midlife improvements to maintain a state of good repair and to increase capacity for planned service expansions.

Pace has installed a ChargePoint CPE 250 Express 62.5kW e-skid mounted charger at Southwest Division.

Conceptual designs propose improvements that increase bus storage capacity to 65 and provide accommodations for BEB charging equipment. It is important to note that the existing structure in the vehicle storage area can support the weight of pantograph chargers today. If warranted, based on the needs of the fleet, electric vehicles can be phased in prior to expanding the footprint of the garage. However, increased electrical service and upgrades to the fire suppression systems would still be needed.

Phasing of the facility modifications for BEBs can potentially minimize impacts to transit operations, with the work to add the additional storage area occurring at a later date as funding allows. The proposed modifications to the administration and driver welfare areas will require temporary relocation of staff to other on-site locations. Additional proposed improvements would include expansion and upgrades to bus storage, maintenance, administrative, training, and driver welfare areas.

Map of Southwest Division Routes Operated by Pace



Communities Served

- Alsip
- Bedford Park
- Blue Island
- Bridgeview
- Burbank
- Chicago
- Chicago Ridge
- Crestwood
- Evergreen Park
- Hickory Hills
- Hodgkins
- Hometown
- Justice
- Midlothian
- Oak Forest
- Oak Lawn
- Orland Park
- Palos Heights
- Palos Hills
- Palos Park
- Robbins
- Summit
- Tinley Park
- Willow Springs
- Worth

Southwest Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

Southwest Division is a pre-engineered building constructed in 1994. Preliminary calculations show that the roof framing can handle the additional loads associated with BEB implementation, but more detailed study is required for final design.

FACILITY MODIFICATIONS

10 percent designs are complete to update, expand, and make accommodations for BEBs at Southwest Division. This division will ultimately be able to house 65, 40-foot BEBs under pantographs.

Other Improvements include:

- Expansion of bus storage area
- Expansion of the bus repair area
- New repair bays
- Removal and replacement of lifts
- Increased parts storage
- New loading dock
- Roof modifications for localized HVAC equipment loads
- Expansion of administrative and employee welfare areas
- Enhancements to fire protection systems
- Electrical upgrades and installation of charging infrastructure
- Upgrades to stormwater management system
- Expansion of employee and guest parking and installation of car chargers

UTILITIES

ComEd will be engaged in design development of an off-property power distribution extension to serve the capacity required to operate full BEB charging facilities. ComEd's design will extend medium voltage (12kV) service to the site property, up to and including equipment at the point of connection to Pace BEB charging equipment. The existing ComEd service (480 volts) will remain in place to feed all non-BEB charging building loads. Provisions for a secondary feed will be coordinated with ComEd.

Modifications will be required to the stormwater management system as the new addition and parking areas will create more impervious areas. The new detention system will be installed below the new parking area.

The existing natural gas service will need to be reevaluated to serve the demand load from 2, 1.5MW generators associated with BEB charging resiliency.

Fire flow test should be conducted as the design is advanced to identify any limitations in serving the increased hazard groups for sprinkler systems in the bus repair and bus storage areas.

ZONING & NEPA COMPLIANCE

Southwest Division will require NEPA approval which, based upon continuation of the current transit use, should be a Categorical Exclusion.

CONSTRUCTABILITY

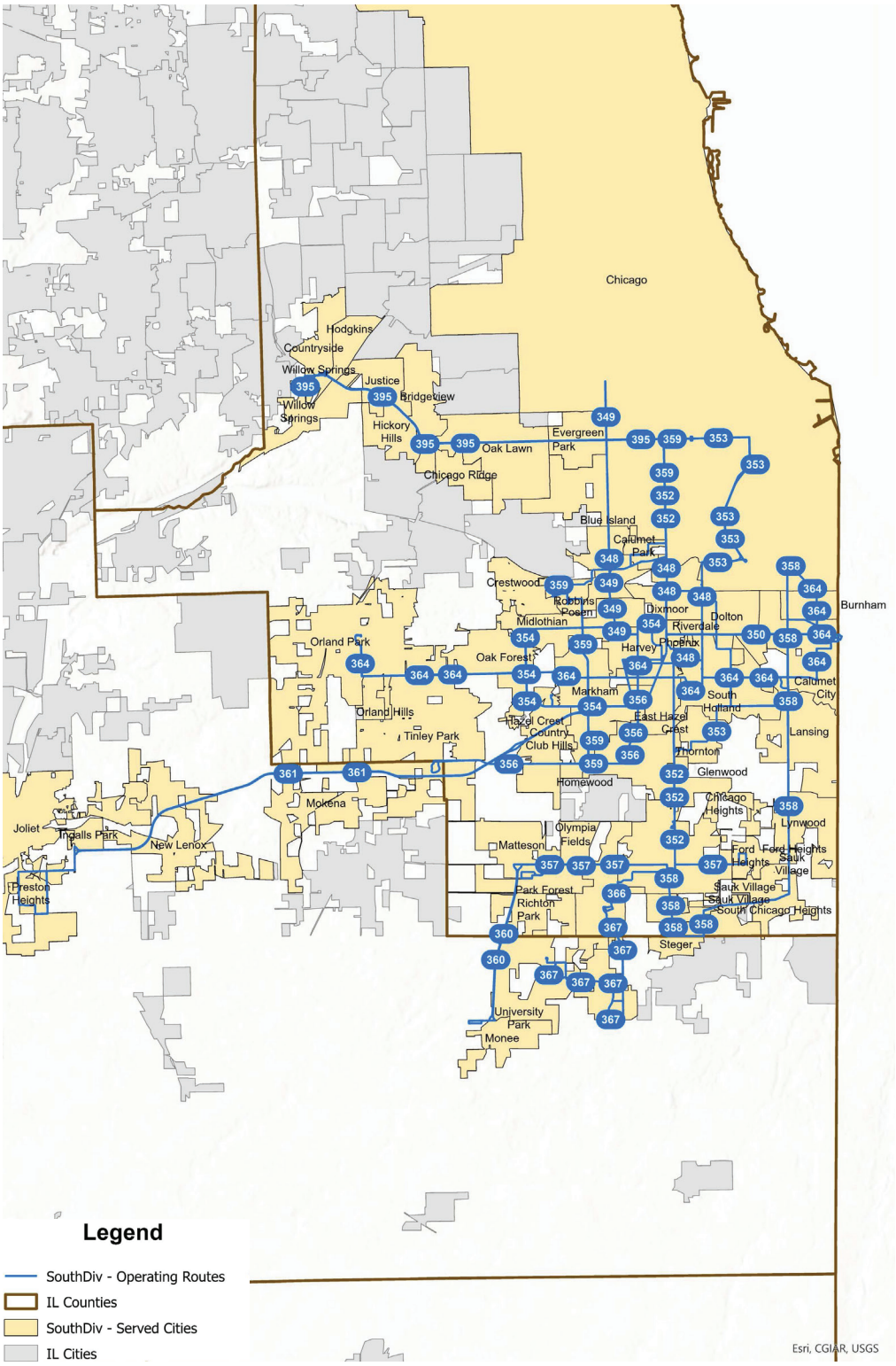
Southwest Division will be constructed in three phases. Phase 1 and Phase 3 can be constructed with the facility remaining operational. Phase 2 requires temporary trailers to accommodate administrative employees and dispatch. Charging infrastructure will be installed in accordance with the BEB implementation plan.

3.4.6 SOUTH DIVISION

South Division in Markham was constructed in 1986 and designed to park 70, 40-transit buses. The property also has outdoor parking for 35, 40-foot transit buses. In 2018, Pace completed midlife improvements to the garage, including the construction of CNG fueling infrastructure. The facility currently operates a fleet of 108, 40-foot buses, 38 over its design capacity. The Bus Storage Area also houses approximately 20 non-revenue vehicles indoors. The division has 209 employee and visitor parking stalls, including 10 accessible parking stalls.

The existing CNG fueling infrastructure can potentially be converted to accommodate hydrogen vehicles. South Division runs a significant number of long blocks that are well suited for FCEBs. As the regional hydrogen generating and fueling infrastructure expands in the future, this could be a viable option for completing longer vehicle blocks that cannot be operated using BEBs. Because South Division is relatively new and supports a fleet of low emission CNG buses, further development of a conversion plan to FCEBs should be delayed until the hydrogen infrastructure to support a transition is fully in place. Among the emerging vendors in the hydrogen market that could serve this division are Linde Hydrogen in East Chicago and Plug Power. Linde produces enough hydrogen to fuel 700 buses a day and can provide deliveries, while Plug Power offers a guaranteed 24-hour delivery schedule. As this market continues to mature, supply can be expected to increase and prices to become more competitive.

Map of South Division Routes Operated by Pace



Communities Served

- Blue Island
- Bridgeview
- Burnham
- Calumet City
- Calumet Park
- Chicago
- Chicago Heights
- Chicago Ridge
- Country Club Hills
- Countryside
- Crest
- Crestwood
- Dixmoor
- Dolton
- East Hazel Crest
- Evergreen Park
- Ford Heights
- Glenwood
- Harvey
- Hazel Crest
- Hickory Hills
- Hodgkins
- Homewood
- Ingalls Park
- Joliet
- Justice
- Lansing
- Lynwood
- Markham
- Matteson
- Mokena
- Monee
- New Lenox
- Oak Forest
- Oak Lawn
- Olympia Fields
- Orland Hills
- Orland Park
- Park Forest
- Phoenix
- Posen
- Preston Heights
- Richton Park
- Riverdale
- Robbins
- Sauk Village
- South Chicago Heights
- South Holland
- Steger
- Thornton
- Tinley Park
- University Park
- Willow Springs

South Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

The building was constructed in 1988 and in 2016 a compressed natural gas (CNG) fueling station was added. In 2018, the building was subject to midlife improvements and converted into a CNG bus maintenance facility

FACILITY MODIFICATIONS

10 percent designs have been developed to expand and make accommodations for hydrogen vehicles at South Division. This division will ultimately be able to house 112 40-foot buses and 20 non-revenue vehicles.

Other Improvements include:

- Expansion of administration and personnel areas
- Expansion of bus storage area
- Expansion of bus repair area
- New repair bays
- Removal and replacement of lifts
- Enhancements to fire protection systems
- New hydrogen storage tanks

UTILITIES

The existing natural gas service and electrical service are not anticipated to require significant upgrades to accommodate the transition from CNG to FCEB.

No changes needed to existing site detention as civil engineers have confirmed there is sufficient capacity for the expansion.

The existing fire pump and system to remain and be expanded. Fire flow test should be conducted as the design is advanced to confirm that the existing fire pump and system can meet final design requirements. Note as this facility is planned to convert to FCEB no provision is made for a specialty fire suppression system that would require utility upgrades to the water service.

New 15KVA transformer and two new panelboards are proposed to support new hydrogen equipment.

ZONING & NEPA COMPLIANCE

South Division will require NEPA approval which, based upon continuation of the current transit use, should be a Categorical Exclusion.

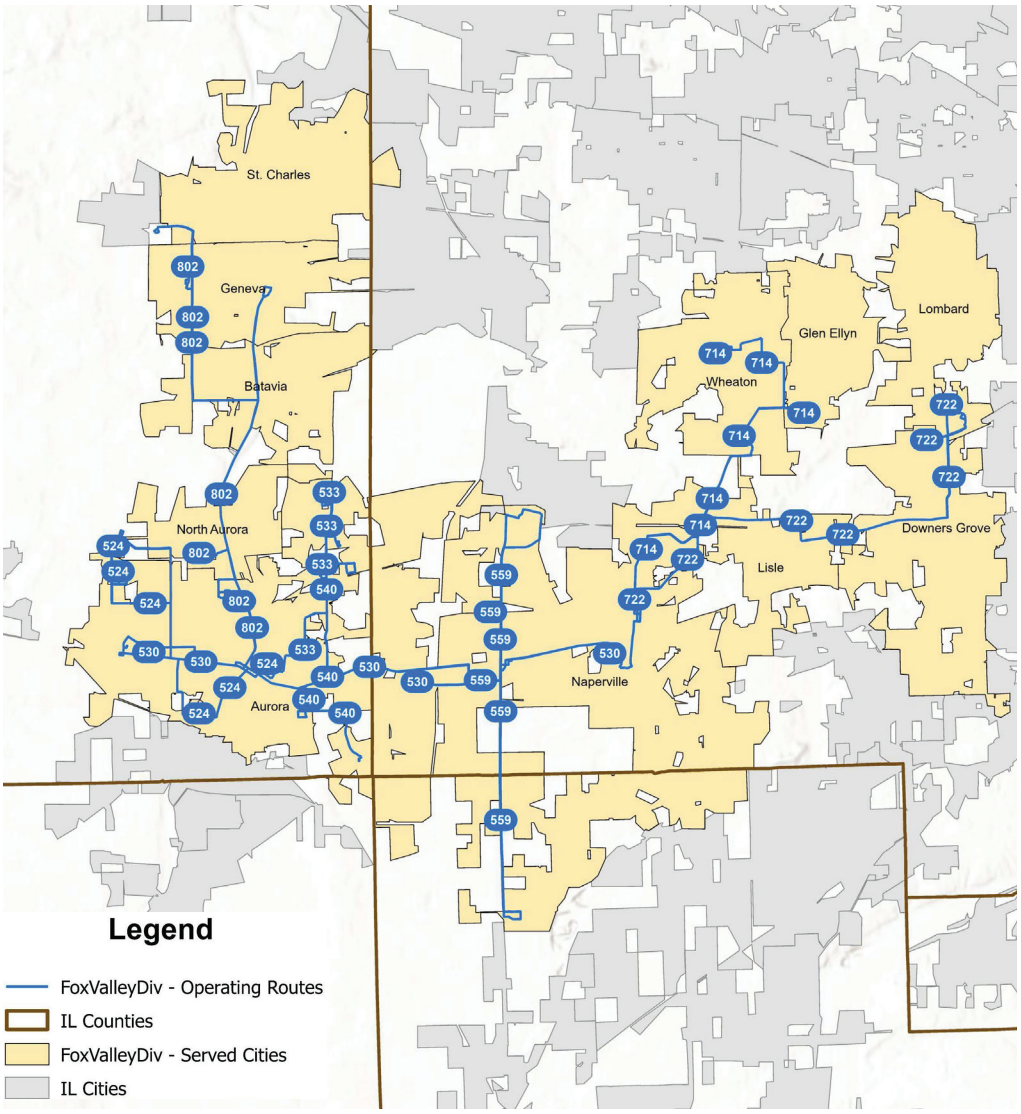
CONSTRUCTABILITY

South Division could be constructed in two phases. Phase 1 upgrades to the existing facility could be managed to maintain ongoing operations, while modifications are made to bus operations, including potential bus relocations. Phase 2 could expand the administration and personnel areas along with bus storage and repair, which will require temporary trailers to

3.4.7 FOX VALLEY DIVISION

Fox Valley Division in North Aurora was constructed in 1994 and was designed to park 20, 40-foot transit buses. The facility provides indoor storage for a fleet of 39, 30-foot buses and approximately 20 non-revenue vehicles. The property also serves as Pace's main safety and training facility and has 80 employee and visitor parking stalls, including 6 accessible parking stalls.

Map of Fox Valley Division Routes Operated by Pace



Communities Served

- Aurora
- Batavia
- Downers Grove
- Geneva
- Glen Ellyn
- Lisle
- Lombard
- Naperville
- North Aurora
- St. Charles
- Wheaton

Fox Valley Division - Summary Of The Plan Implementation

EXISTING CONDITIONS

Fox Valley Division is a pre-engineered building constructed in 1994. Preliminary calculations show that the roof framing can handle the additional loads associated with BEB implementation, but more detailed study is required for final design.

FACILITY MODIFICATIONS

10 percent designs have been developed to update, expand, and make accommodations for BEBs at Fox Valley Division. This division will ultimately be able to house 64, 40-foot BEBs under pantographs.

Other Improvements include:

- Expansion of administration and personnel areas
- Expansion of bus storage area
- Expansion of bus repair area
- New repair bay
- New loading dock ramp and new roll-up doors
- New roofing
- Fall protection
- Removal and replacement of lifts
- Increased parts storage
- Enhancements to fire protection systems
- Electrical upgrades and installation of charging infrastructure
- New mechanical exhaust and make-up air system and New Energy Recovery Unit
- Upgrades to stormwater management system
- Expansion of employee and guest parking and installation of car chargers

UTILITIES

The existing natural gas service will need to be reevaluated to serve the demand load from 2, 1.5MW generators associated with BEB charging resiliency.

Provisions for a secondary feed will be coordinated with ComEd.

ZONING & NEPA COMPLIANCE

Fox Valley Division will require NEPA approval which, based upon continuation of the current transit use should be a Categorical Exclusion.

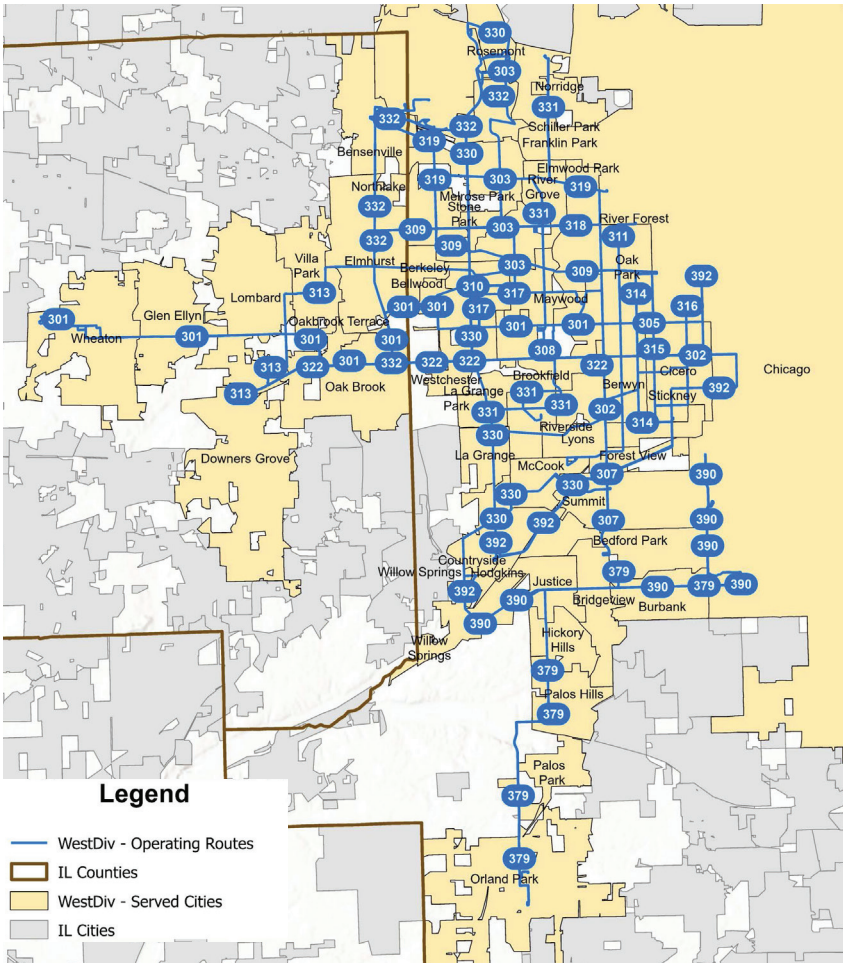
CONSTRUCTABILITY

Due to the challenge of maintaining operations during construction, a temporary facility at an alternate site may be necessary.

3.4.8 WEST DIVISION

West Division, located in Melrose Park, was constructed in 1986 and the building was subject to midlife improvements in 2019. The facility has a maximum capacity of 140, 40-foot buses and is currently storing 136 buses. Ten percent design was not completed for West Division due to the recent midlife improvements. The timeline of construction is therefore further out in the transition plan, as it is considered more prudent to develop the detailed plan closer to planned transition to ZEB to best align to the current technology at that time. Design will be conducted during a later iteration of the facility transition plan.

Map of West Division Routes Operated by Pace



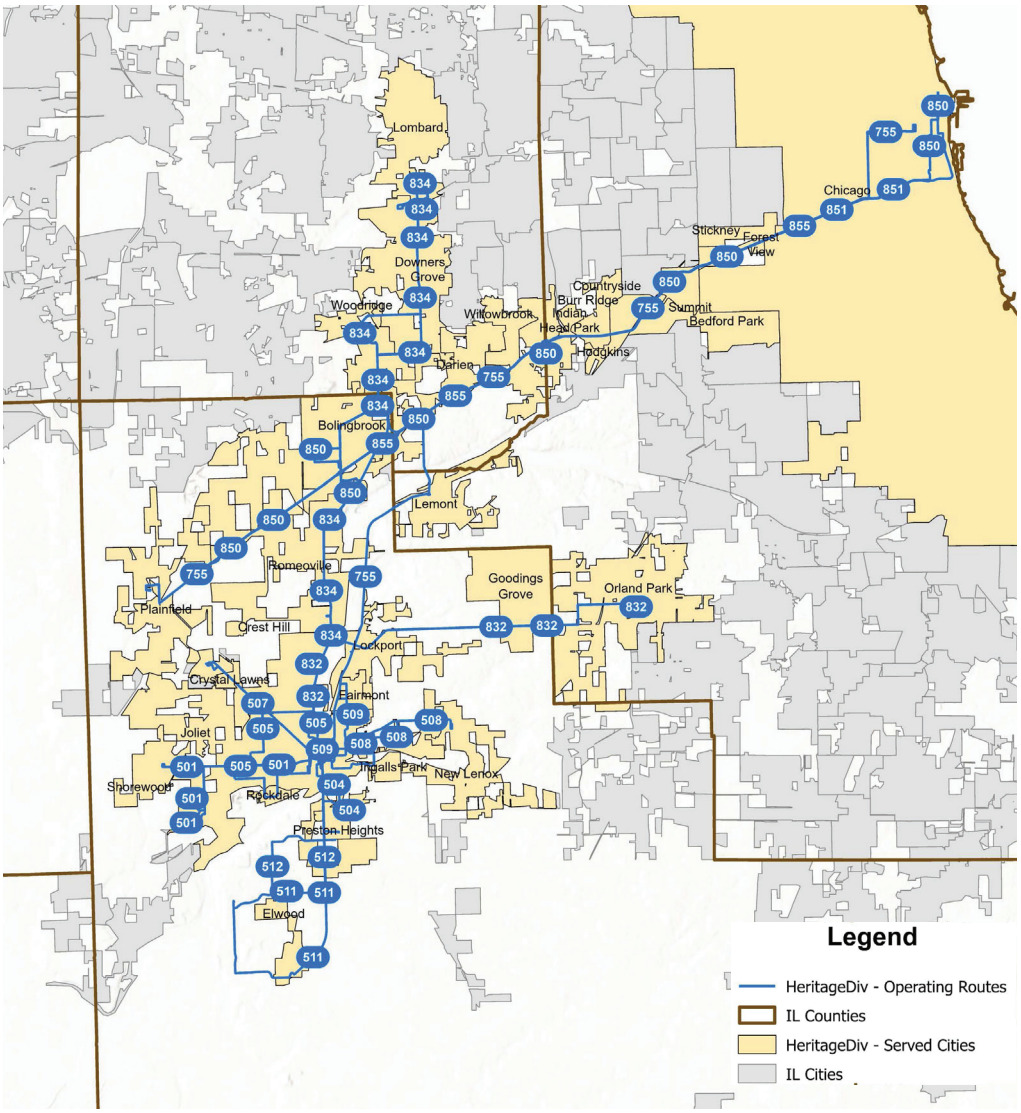
Communities Served

- Bedford Park
- Bellwood
- Bensenville
- Berkeley
- Berwyn
- Bridgeview
- Brookfield
- Burbank
- Chicago
- Cicero
- Countryside
- Downers Grove
- Elmhurst
- Elmwood Park
- Forest View
- Franklin Park
- Glen Ellyn
- Hickory Hills
- Hodgkins
- Justice
- La Grange
- La Grange Park
- Lombard
- Lyons
- Maywood
- McCook
- Melrose Park
- Norridge
- Northlake
- Oak Park
- Oakbrook
- Oakbrook Terrace
- Orland Park
- Palos Hills
- Palos Park
- River Forest
- River Grove
- Riverside
- Schiller Park
- Stickney
- Stone Park
- Summit
- Villa Park
- Westchester
- Wheaton
- Willow Springs

3.4.9 HERITAGE DIVISION

Heritage Division is Pace's newest facility, which opened in October 2022. The facility has a capacity for 135 buses, allowing for future growth in Pace's operations in Will County. At this time, the future propulsion type has not been determined for the facility. Heritage Division has an operational 180kW Proterra charger with two plug-in dispensers as well as two ChargePoint employee car chargers.

Map of Heritage Division Routes Operated by Pace



Communities Served

- Bedford Park
- Bolingbrook
- Burr Ridge
- Chicago
- Countryside
- Crest Hill
- Crystal Lawns
- Darien
- Downers Grove
- Elwood
- Fairmont
- Forest View
- Goodings Grove
- Hodgkins
- Indian Head Park
- Ingalls Park
- Joliet
- Lemont
- Lockport
- Lombard
- New Lenox
- Orland Park
- Plainfield
- Preston Heights
- Rockdale
- Romeoville
- Shorewood
- Stickney
- Summit
- Willowbrook
- Woodridge

4 Funding

Substantial capital funding assistance will be needed from state, federal, and regional entities to replace Pace's existing fleet and upgrade facilities to accommodate ZEBs.

4.1 CHALLENGES AND OPPORTUNITIES

As Pace works towards the goal of having a zero-emissions fleet by 2040, external challenges include the limited number of Original Equipment Manufacturers (OEMs) producing vehicles and charging infrastructure, supply chain issues for construction materials, and shortages of skilled labor in both the design and construction industries. The total cost of a ZEB encompasses multiple variables, including investments in new rolling stock and facility infrastructure.

ZEBs are currently more expensive than conventional diesel and CNG buses, with BEBs costing twice as much and FCEBs costing about 2.5x more. Additionally, batteries, facility modifications, and charging equipment require significant upfront investment. However, as the technology matures, the cost of ZEBs is predicted to decline, while the efficiency of battery capacities is predicted to increase.

In addition to high upfront capital costs, there are operational impacts incurred from the switch to ZEBs. These include increased operational costs due to route and schedule changes, increased electrical demand, extended service and maintenance agreements with vendors, and modification to maintenance practices, including workforce hiring, training, and retention. While operational costs increase in the transition to ZEBs, the long-term operational costs are expected to decline due to lower fueling and maintenance costs of the ZEBs.

4.2 FUNDING AND PROCUREMENT EFFORTS TO DATE

The Zero-Emission Bus Transition Plan requires that each facility is upgraded in advance of the replacement of the existing fleet to ensure the bus fleet retains its operational effectiveness and all capital is wisely invested. Despite the reduced farebox revenues and upfront capital investments necessary to advance the

plan, the *Infrastructure Investment and Jobs Act (IIJA)* presents significant funding opportunities for transit agencies, including increased funding for new and existing discretionary grant programs. To date, Pace has applied to the following programs.

- *2022 Low or No Emission Grant Program and the Grants for Buses and Bus Facilities Competitive Program:* Pace submitted an application for funding through the 2022 Program to expand and modify North Division to support electric vehicle operations and to purchase two BEBs. The grant funding was also to be used to invest in training operators, support staff, and mechanics on the BEB fleet. *(This grant application was not awarded by FTA.)*

- *2022 Advanced Driver Assistance Systems (ADAS) for Transit Buses Demonstration and Automated Transit Bus Maintenance and Yard Operations Demonstration Program:* Pace submitted an application for funding through the ADAS Program in fall 2022, called the *Pace Advanced Unified Technology Option for Busyard Usability demonstration System Project* (AUTOBUS). The project proposes to develop a systematic and scalable approach to assessing the feasibility, effectiveness, benefits, and costs of integrating ADAS automation technologies into transit bus maintenance and storage facilities. The project is proposed for Pace's Heritage Division and will retrofit three of Pace's existing buses with Perrone Robotics' existing and proven technology package, *To Navigate You/Mobile Autonomous X* (TONY/MAX) automation kit. The fundamental application of ADAS from the BEB perspective is the ability to remotely drive buses. In the event of a thermal runaway event on a BEB in the bus storage area, Pace will be able to move adjacent buses and reduce the impact of the thermal event. Ultimately the affected bus can be towed out of the garage to a designated area, where the event can be managed safely. *(This grant application was not awarded by FTA. Pace submitted an FY23 SMART Grant Application on October 10, 2023.)*

- *2023 Low or No Emission Grant Program and the Grants for Buses and Bus Facilities Competitive Program:* Pace applied for funding through the 2023 program. With this grant funding, Pace would expand and modify North Division to support electric vehicle operations and to purchase two BEBs. The grant funding would also be used

to invest in training operators, support staff, and mechanics on the BEB fleet. *(This grant application was not awarded by FTA.)*

In June 2019, the Illinois General Assembly passed the *Rebuild Illinois* Capital Bill, which provided Pace with $228 million in funding and established "PAYGO" as an ongoing, reliable funding source for future capital needs based on the motor fuel tax. Pace expects to receive approximately $73 million of PAYGO funds between 2023-2027 and plans to use these funds as local match for federal grants.

Pace receives Federal CMAQ funding, which is a competitive grant program administered by the MPO. To date, Pace has not applied for CMAQ funding for a garage project.

Pace also received Federal 5307/5339 funds. Historically, federal formula capital funds have been allocated among the service boards at the following percentages: 58 percent to CTA, 34 percent to Metra, and 8 percent to Pace. The federal formula funds, which include Section 5307/5340 Urbanized Area and Section 5339 Bus and Bus Facilities, are expected to total $289.688 million for Pace in 2023-2027. Estimates of funding for the federal formula program are aligned with the new *Infrastructure Investment and Jobs Act (IIJA)* signed into law on November 15, 2021.

As part of this legislation, the Federal government has earmarked record amounts of funding for zero-emissions transit projects. However, the programs are highly competitive. Additionally, supply chain issues, skilled labor shortages, and general inflation have created extraordinary escalation of construction and vehicle costs across all markets. As such, the cost of related charging and fueling infrastructure is very high, making the conversion of the smallest Pace division a more than $100 million proposition. Potential funding opportunities are included in **Appendix F**.

5 Next Steps

Given the rapid evolution of zero-emissions technologies, this *Zero-Emission Bus Facility Plan*, as well as the *Zero-Emission Bus Transition Plan*, will require periodic updates to adapt to technological advances.

5.1 PROJECT DELIVERY

As Pace moves forward into full design and construction, there are presently two methods of project delivery being considered:

Traditional Design-Bid-Build (DBB) refers to the historically used project delivery method where the owner hires a designer and works with them to develop plans to a level of detail appropriate for construction bidding. The project is then advertised for bids. Upon receipt of proposals, the owner selects a contractor to construct the project. Because roles are clearly defined, the owner receives the most transparency through the design process, and project costs are generally known due to the level of detailed design. Drawbacks include potentially longer project timelines due to multiple procurements, reduced opportunities for collaboration between the owner, designer, and the contractor, and change order management.

Progressive Design-Build (PDB) refers to the process where the project design is developed by the owner and the design-builder in a step-by-step process. Under this project delivery method, a PDB contractor is selected via a qualifications-based procurement. The contractor then works collaboratively with the owner to fully design a project. The PDB and owner then negotiate a guaranteed maximum price (GMP) for construction. If an agreed amount for the GMP cannot be negotiated, the owner maintains control of project designs, and has the right to seek outside bids for construction.

For this delivery method, Pace developed "bridging documents" which establish the programmatic requirements, project vision, and objectives. These documents include summaries of work, performance criteria, technical specifications, preliminary designs developed to a 10 percent or 30 percent

level of completion, and reference materials that will be used by contractors to better understand the planned work and inform their bids.

The PDB delivery method allows the owner, designer, and construction team to collaborate throughout all stages of project development, providing the greatest amount of engagement between the three key players in a construction contract. Under this method, the design and construction contractor are treated as a singular entity by the owner. This provides for more accountability while providing the owner with greater control of the budget and throughout the iterative design process. Drawbacks include potentially higher project costs since the initial award is based on qualifications not price, restrictive procurement regulations that may limit collaboration, and preferred subcontractor participation.

5.2 APPLICATION OF FACILITY PLAN

While this Facility Plan is focused on BEBs, as the development of hydrogen hubs expands, FCEBs should be considered for Pace's longer vehicle blocks.

The PEER analysis discussed in **Section 1** is a conservative approach based on the best information available today for existing and future battery technology. However, given the speed of technological advances, the results of the PEER analysis should be reviewed and, in some instances, re-run to confirm contemporary applicability, as potential improved efficiencies could be realized.

Facility assessments and bridging documents are intended to guide final design teams by providing insight into the condition of building elements and equipment. Given the disruptive nature of the introduction of charging infrastructure and related systems into a division, sound judgment can be applied towards future comprehensive facility upgrades. The 30 percent design-bridging documents provided for North, Northwest Wheeling, and River Divisions provide direction for final design and construction. Ten percent packages for the balance of the divisions include scope narratives, conceptual drawings, and cost estimates informed by site assessments and the projected vehicle counts inclusive of possible fleet size increases.

5.3 TECHNOLOGY, INFRASTRUCTURE, AND INNOVATION

Zero-emissions technology is advancing rapidly due to funding made available by the Federal Transit Administration (FTA), Department of Energy (DOE), and the Defense Advanced Research Projects Agency (DARPA). A combined investment of approximately $110 billion has yielded several significant advances in energy storage and propulsion system efficiency. Electrical grid improvements and the creation of several hydrogen hubs across the United States are also in the advanced stages of implementation. While these advances are developing quickly, the application of agreed-upon design and operation standards are in flux. To ensure that the investment Pace makes today will be of high value over the entire course of the agency's transition to zero-emissions vehicles, ongoing coordination with regulatory, research, and funding agencies will be imperative.

5.4 TRANSIT SERVICE DYNAMICS

Pace schedules are continuously monitored and audited to provide the highest level of quality service to customers. The results are reported to the FTA for inclusion in the National Transit Database (NTD) to certify that FTA investments are fully utilized. In addition to being used as a compliance certification tool, the ridership counts provide Pace with the basis for adjusting bus operating schedules on a quarterly basis. Long-term trend analyses are also applied to determine division-level fleet requirements that necessitate bus relocations between garages. These shifts in service, as well as bus relocations to balance out fleet age amongst all divisions, need to be continuously factored into the ongoing facility planning efforts as Pace transitions to a zero-emissions fleet. As part of the effort that Pace undertakes to continuously analyze ridership utilizing Automatic Passenger Count (APC) data and ensure compliance with FTA Passenger Load Guidelines, Pace should also conduct PEER analyses on an annual basis or more frequently if there is a substantial change in the block schedule at any division. This recurring PEER analysis will confirm performance expectations can be met, particularly for larger, more comprehensive system reorganizations.

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driving.innovation@pacebus.com • pacebus.com/zero