PUBLIC MEETING AGENDA

Transportation Commission

MEETING DATE
Tuesday, September 14, 2021 at 7:30 a.m.

MEETING LOCATION

https://tempe.webex.com/tempe/onstage/g.php?MTID=e8f15334b2ea9c4d976c2449e3c35e4c8
Join Via Cisco Webex Meeting
Event password: cCUE8rTq5m8
United States Toll+1-408-418-9388
Access Code/Event Number: 146 543 8421

AGENDA ITEM	PRESENTER	ACTION or INFORMATION
1. Public Appearances The Transportation Commission welcomes public comment for items listed on this agenda. There is a three-minute time limit per citizen.	JC Porter, Commission Chair	Information
2. Approval of Meeting Minutes The Commission will be asked to review and approve meeting minutes from the June 9, 2021 meeting.	JC Porter, Commission Chair	Action
3. Welcome New Commissioner Alice Bimrose	JC Porter, Commission Chair	Information
4. Electrification of Bus Fleet Staff will present information related to the regional effort to include electric buses in its fleet.	Mackenzie McGuffie, Valley Metro and Sam Stevenson, Engineering & Transportation Department	Information
5. Regional Transit Fare Collection System Staff will provide an update on the progress of implementing a new region-wide fare collection system.	Joe Bowar, City of Phoenix, Tyler Olson, Valley Metro and Sam Stevenson, Engineering & Transportation Department	Information
6. Climate Action Plan Information will be provided on the status of the Climate Action Plan.	Braden Kay, Sustainability Office	Information
7. Streetcar Update Information on the status of the streetcar including final construction and anticipated operations will be discussed.	Tony Belleau, Engineering & Transportation Department	Information

8 . Department & Regional Transportation Updates Staff and commission members will provide information on relevant meetings and events.	Engineering & Transportation Department Staff and Transportation Commissioners	Information
9. Future Agenda Items Commission may request future agenda items .	JC Porter, Commission Chair	Information

According to the Arizona Open Meeting Law, the Transportation Commission may only discuss matters listed on the agenda. The city of Tempe endeavors to make all public meetings accessible to persons with disabilities. With 48 hours advance notice, special assistance is available at public meetings for sight and/or hearing-impaired persons. Please call 350-4311 (voice) or for Relay Users: 711 to request an accommodation to participate in a public meeting.

Minutes
City of Tempe Meeting of the Transportation Commission
June 8, 2021

Minutes of the meeting of Tempe Transportation Commission held on Tuesday, June 8, 2021, 7:30 a.m. via Cisco Webex.

(MEMBERS) Present:

Jeremy Browning
Alana Chavez Langdon
John Federico
Brian Fellows
Pam Goronkin
David Sokolowski
JC Porter
John Christoph
David A. King
Peter Schelstraete
Bobbie Cassano
Susan Conklu
Dawn Hocking
Paul Hubbell

(MEMBERS) Absent: None

City Staff Present:

Abel Gunn, Transportation Financial Analyst
Laura Kajfez, Neighborhood Services Specialist
Amanda Nelson, Public Information Officer
Marilyn DeRosa, Engineering & Transportation Director
Eric Iwersen, Transit Manager
Cathy Hollow, Traffic Engineer
Julian Dresang, Deputy Engineering & Transportation Director
Tony Belleau, Streetcar Project Manager
Isaac Chavira, Interim Deputy Engineering & Transportation Director
Ambika Adhikari, Principal Planner
Sam Stevenson, Senior Transportation Planner
Robert Yabes, Principal Planner
TaiAnna Yee, Public Information Officer
Sue Taaffe, Senior Management Assistant
Shauna Warner, Neighborhood Program Manager
Chase Walman, Planner II
Rebecca Rothman, Arts Administrator
James Sweig, Lieutenant
Ed Bond, Senior Civil Engineer
Jeff Yazzie, Civil Engineer
Nanette Odell, ADA Compliance Specialist

Guests Present:

Bobby Zokaites
Jessica Parks
Ray Carranza
Jason Harrington
Robert Forrest

Commission Chair JC Porter called the meeting to order at 7:32 a.m.

Agenda Item 1 – Public Appearances

None

Agenda Item 2 – Minutes

JC Porter introduced the minutes of the May 18 meeting of the Transportation Commission and asked for a motion for approval.

Motion: Commissioner David King
Second: Commissioner Paul Hubbell
Decision: Approved by Commissioners

Jeremy Browning
John Federico
Brian Fellows
Pam Goronkin
David Sokolowski
JC Porter
Paul Hubbell
John Christoph
David A. King
Peter Schelstraete
Bobbie Cassano
Susan Conklu
Dawn Hocking

Agenda Item 3 – Title VI Major Service Change and Service Equity/Fare Equity Policy
Robert Forrest with Valley Metro provided an update on the proposed Title VI policy changes. Topics included:

- Title VI background
- Title VI policies
- Service changes and equity policy
- Fare equity policy
- Community involvement

Commissioners were encouraged to go the Valley Metro web site to submit official public comment.

Agenda Item 4 - Character Area 1 Papago / North Tempe Plan
Ambika Adhikari gave an update on the Character Area 1 Papago / North Tempe project. Topics included:

- Background
- Demographics
- Public meetings
- Survey responses
- Design principles
- Next steps

Discussion included access to stores where residents may purchase medication and food.

Commissioners were asked to email Ambika Adhikari answers to the following questions:

1. What priority(ies) listed here would best help this Commission serve the interest of the community?
2. Are there any priorities not listed which would better help this Commission serve the community?

Agenda Item 5 – ADA and Sidewalk Infrastructure
Nanette Odell, Jeff Yazzie and Ed Bond updated the Commission on the status of the ADA Transition Plan. Topics included:

- Background
- Performance measures
- Phase I
- Phase II
- Phase III
- Completed projects
- Active transportation projects

- Future projects

Discussion included Orbit flag zones, Title VI and the ADA Transition Plan as it relates to transit service changes, and how projects are determined to be categorized as complete.

Agenda Item 6 - Country Club Way Bicycle and Pedestrian Improvement Project
Chase Walman, Bobby Zokaites, Ray Carranza and Jason Harrington presented the 60% design plans for the project. Topics included:

- Background
- 30% design feedback
- 60% design
- Public art component
- Landscaping
- Next steps

Discussion included crosswalks and the intersection of Shutterfly and Elliot.

Agenda Item 7 - Speed Enforcement
Lieutenant James Sweig provided an update about Tempe's Traffic Bureau Division as it relates to speed enforcement. Topics included:

- Purpose
- Mission (enforcement and education)
- Reasons for collisions
- Injuries and fatality locations
- Proactive enforcement/SEMS program
- Street racing

Discussion included street racing, educational outreach and marijuana as it relates to DUI.

Agenda Item 8- Upcoming Transportation Public Meetings & Announcements
JC Porter announced that the July meeting has been canceled and that the August meeting will be in person.

Agenda Item 9 – Future Agenda Items
The following future agenda items have been previously identified by the Commission or staff:

- July 13 - Canceled
- August 10
    1. Transit Fund & Program Update
    2. Scottsdale Road Bike Lanes
    3. Streetcar Construction Update
    4. Ash/University Intersection & 1st/Ash/Rio Roundabout Update
- September 14
    1. Regional Transit Fare Collection Systems
    2. Transit Shelter Design
    3. Climate Action Plan 2021 Update
    4. Open Streets
    5. Electrification of Buses
- October 12
    1. Annual Report

2. Commuter Rail Study/ MAG Commuter Rail Plan
3. AZ State Rail Plan/AZDOT Phoenix-Tucson Corridor Plan
4. Streetscape Transportation Enhancement Program
5. North/South Rail Spur MUP

- November 9
  1. Transit Security Update
  2. Crosswalk Signal Countdown & Signal Detection for Bicycles
- December 14
  1. Personal Delivery Devices
  2. Transit Fund & Program Update
  3. Mobility Hubs
  4. Transportation Demand Management Plan/Transportation Management Association
- TBD: BRT Study
- TBD: Bike Bait (once program resumes)

The next meeting is scheduled for August 10, 2021 in the Don Cassano Community Room located at 200 E. Fifth Street, Tempe.

The meeting was adjourned 9:34 a.m.

Prepared by: Sue Taaffe
Reviewed by: Isaac Chavira

MEMORANDUM

TO: Transportation Commission

FROM: Eric Iwersen, Interim Deputy Engineering and Transportation Director (480-350-8810)
Sam Stevenson, Interim Transit Manager (480-858-7765)

DATE: September 14, 2021

SUBJECT: Electrification of Bus Fleet

PURPOSE

The purpose of this memo is to provide the Commission with an update on staff efforts to explore the latest battery-electric bus technology and road-mapping of a small-scale initial investment for further exploration and testing.

CITY COUNCIL STRATEGIC PRIORITY

- Quality of Life 3.26: Achieve a multimodal transportation system (20-minute city) where residents can walk, bicycle, or use public transit to meet all basic daily, non-work needs.
- Quality of Life 3.29: Achieve ratings of "Very Satisfied" or "Satisfied" with the "Overall Satisfaction with Transit System in Tempe" greater than or equal to 80% as measured by the City of Tempe Transit Survey.

BACKGROUND

Over the past several years, the City of Tempe has remained engaged in emerging transit vehicle technologies including alternatively fueled vehicles and zero-emission vehicles for future fleet replacement considerations. During the summer of 2020, the city partnered with Valley Metro and three electric vehicle manufacturers: Proterra, BYD, and New Flyer, to simulate revenue service in our harsh desert climate while assessing the performance of the vehicles – which were equipped with some of the latest advancements in electric vehicle technology. For the first time in recent years, staff observed that the electric buses included in the demonstration performed at a satisfactory level, meaning the vehicles operated reliably and achieved the operating range necessitated by some of our existing vehicle schedules. A report detailing the methodology and results of testing that was completed during 2020 is attached. Following the results of the demonstration, and in pursuit of a small-scale investment to further introduce and evaluate the technology in our region, the City worked with Valley Metro, the City of Phoenix, Salt River Project and bus manufacturer New Flyer to develop and submit a competitive grant application for the Federal Transit Administration's Low and No Emission Vehicle Program (LowNo), which provides a significant federal match for electric vehicle infrastructure and vehicles, for the fiscal year 2021 application cycle. The LowNo grant opportunity was highly completive and funding was not awarded to our application, however staff continue to explore future LowNo and alternative funding opportunities to support a small-scale initial investment in electric bus technology to include up to eight buses and necessary charging infrastructure.

RECOMMENDATION OR DIRECTION REQUESTED

Information only

FISCAL IMPACT or IMPACT TO CURRENT RESOURCES

Total cost for the proposed eight-bus small-scale initial investment is estimated at approximately $9 million. If awarded in future, the LowNo program could provide up to 85% federal match for rolling stock and a 90% federal match for charging infrastructure. Regional Proposition 400 funding (PTF), Tempe Transit Tax (CIP) funding, and contributions from Salt River Project have also been identified as potential local matching funds. Funding currently programmed to replace existing fleet could potentially provide a contribution toward the total cost of the electric bus initial investment.

ATTACHMENTS

1. PowerPoint
2. Report: Electric Bus Study, Summer 2020

Electrification of Buses

Transportation Commission
September 14, 2021

Tempe

VALLEY METRO

City Council Strategic Priority Performance Measures

Quality of Life 3.26

Achieve a multimodal transportation system (20-minute city) where residents can walk, bicycle, or use public transit to meet all basic daily, non-work needs.

Quality of Life 3.29

Achieve ratings of “Very Satisfied” or “Satisfied” with the “Overall Satisfaction with Transit System in Tempe” greater than or equal to 80% as measured by the City of Tempe Transit Survey.

Agenda

- Tempe Assets – facilities and fleet
- Electric Buses in Tempe
- Overview of Electric Bus Technology
- Summer 2020 Testing
- Lessons Learned and Next Steps
- Electric Bus Initial Investment

Tempe Assets – Facilities and Fleet

- East Valley Bus Operations and Maintenance (EVBOM) Facility
  - 2007
  - LEED Gold certification
  - 250+ bus capacity
- Tempe Transportation Center
- Fixed-Route Bus Fleet
  - 120 buses (Orbit/30', 40', Articulated/60')
  - 100% Alternatively Fueled (CNG, LNG, diesel-electric hybrid)

Electric Buses in Tempe

1996: Tempe Transit Tax Passes
Funding proposal envisions low-emission or zero-emission fleet

1998: City Procures Electric Buses
Combination of battery-electric and LNG electric hybrid buses for neighborhood circulator service


2006: Ebus Project Terminated
Following numerous delays, performance issues, mechanical failures, supplier bankruptcy, and inability to correct deficiencies

2015: BYD Bus Demo
Electric Bus Manufacturer BYD demonstrates their 40' Electric Bus to staff at EVBOM facility

2019: Proterra Bus Demo
Electric Bus Manufacturer Proterra demonstrates the 40' "Catalyst" Electric Bus to staff at EVBOM facility


2016: Electric Bus Testing, ORBIT
Electric bus manufacturer BYD provided their 30' "K7M" Electric Bus for four weeks of in-service testing on all five ORBIT routes.

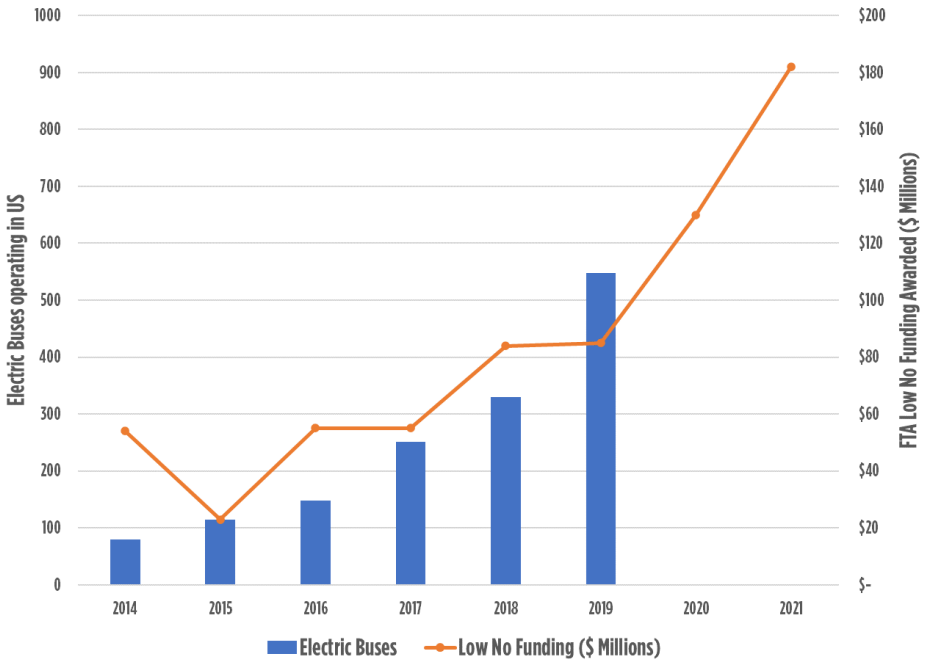
2020: Electric Bus Testing, FLASH and local bus
The City partnered with Valley Metro and electric bus manufacturers Proterra, BYD, and New Flyer to perform multi-day simulated testing along the ASU FLASH route



2021: FTA Low No Grant
Joint application filed; partnership between City of Phoenix, Valley Metro, and City of Tempe. No funding was awarded to the region

Electric Buses – Technology and Trends

- Increasing adoption of electric buses
- Increased availability of dedicated FTA Low No funding
- Expanded selection of available vehicle specifications and types
- Expanded selection of charging infrastructure technology solutions
- CA: Zero-Emission Transit Fleets by 2040



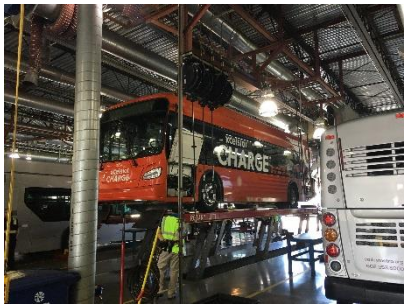
Source: Federal Transit Administration, National Transit Database

Summer, 2020 Testing

- Three manufacturers and vehicles
  - Proterra 35’ Bus
  - BYD 40’ Bus
  - New Flyer 35’ Bus
- Simulated revenue service during summer
  - ASU FLASH (circulator service)
  - Route 56 (local bus service)
  - Various loading conditions
  - Simulated schedules and stops
- Extensive data monitoring and analysis
- Favorable results: 2 of 3 vehicles completed testing with satisfactory performance

Lessons Learned and Next Steps

- Positive outlook for electric buses in our environment
  - Battery capacity adequate for some vehicle schedules within our existing service model
  - Overnight charging at EVBOM facility without the need for on-route charging
- Performance dependent on several variables – data collection is key!
- Larger vehicles = longer range
- Infrastructure planning is critical
  - Partnerships with utility providers
- Next Steps: small-scale initial investment



Electric Bus Initial Investment

- 8 battery electric buses
- 8 charging stations at EVBOM
- Goals & Benefits
  - Understand range, battery degradation and long-term performance of buses
  - Gain experience operating electric buses (especially applicable to service planners, operators and maintenance staff)
  - Obtain cost data specific to the Valley
  - Prepare for future state or federal policies

Funding the Initial Investment

- While there is potential for long-term savings, there is a larger upfront cost to electric buses
  - 1 electric bus + 1 charging station = approx. $1 million
  - 1 compressed natural gas bus = approx. $550,000
- FY21 Low/No Emissions Grant Application
  - Highly competitive federal grant that supports the purchase of electric buses and charging stations for transit
  - 85/15 match for buses and 90/10 match for charging stations
  - Joint application between City of Tempe, City of Phoenix and Valley Metro
  - Utility partnership with SRP
  - Grant application unsuccessful – less than 1/3 of applicants were awarded funding

Funding the Initial Investment

- Valley Metro staff remains engaged in funding this project
- Future Funding Opportunities
  - FY21 Bus & Bus Facilities Grant
  - FY22 FTA Low/No Emissions Grant
  - Tempe Local Match – EVBOM CIP electrification infrastructure
  - SRP Incentives and Partnership
  - Additional funding opportunities anticipated with passing of the American Jobs Plan

Questions

Sam Stevenson
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Sam_Stevenson@tempe.gov
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Mackenzie McGuffie
Sustainability Coordinator
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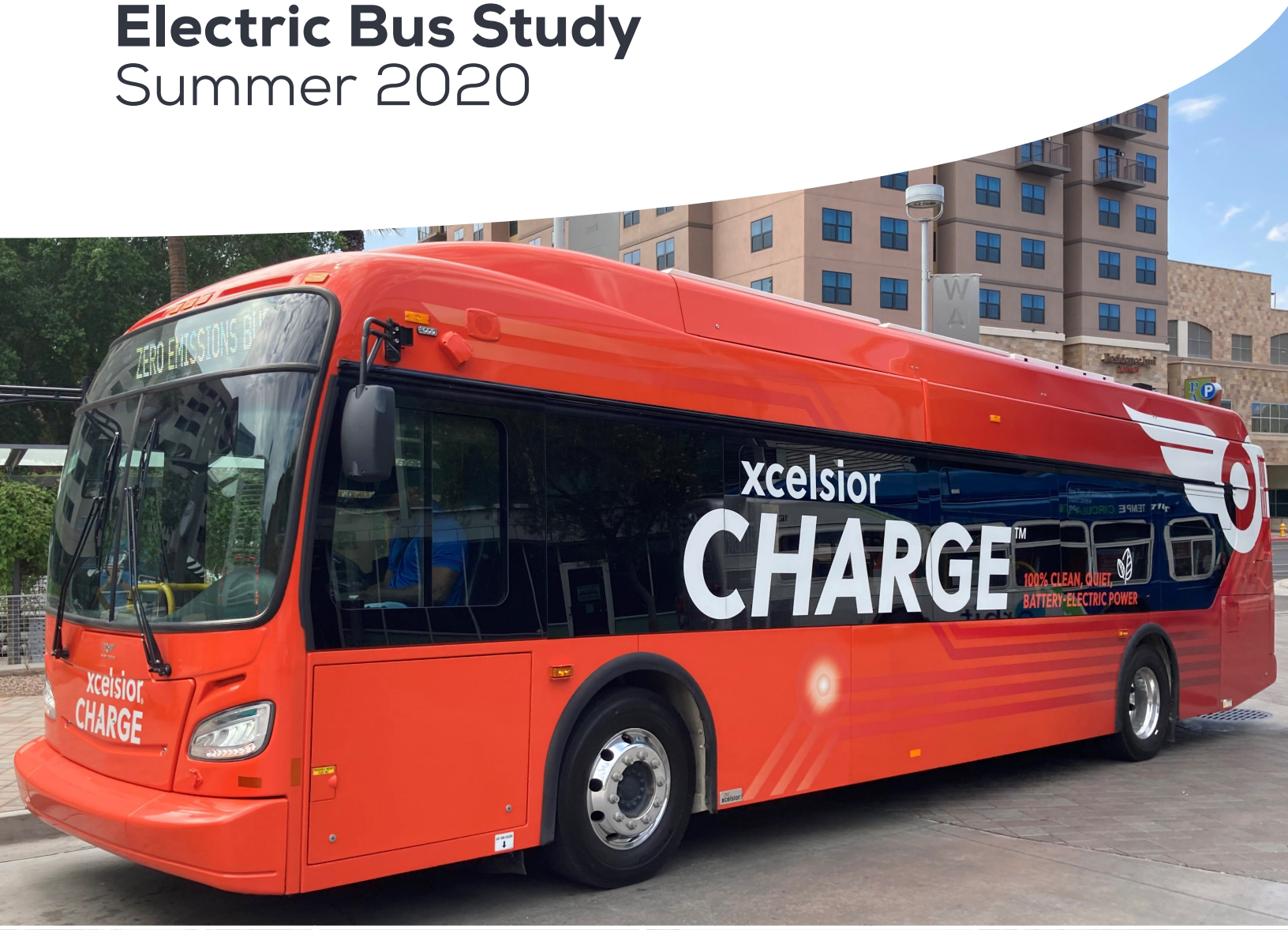
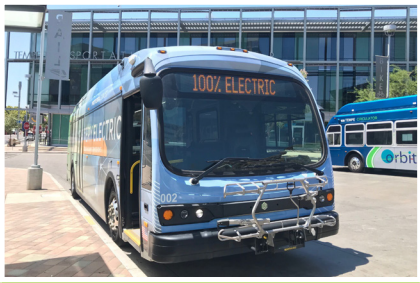
Tempe

VALLEY METRO

VALLEY METRO

Electric Bus Study
Summer 2020





VALLEY METRO

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E EXECUTIVE SUMMARY

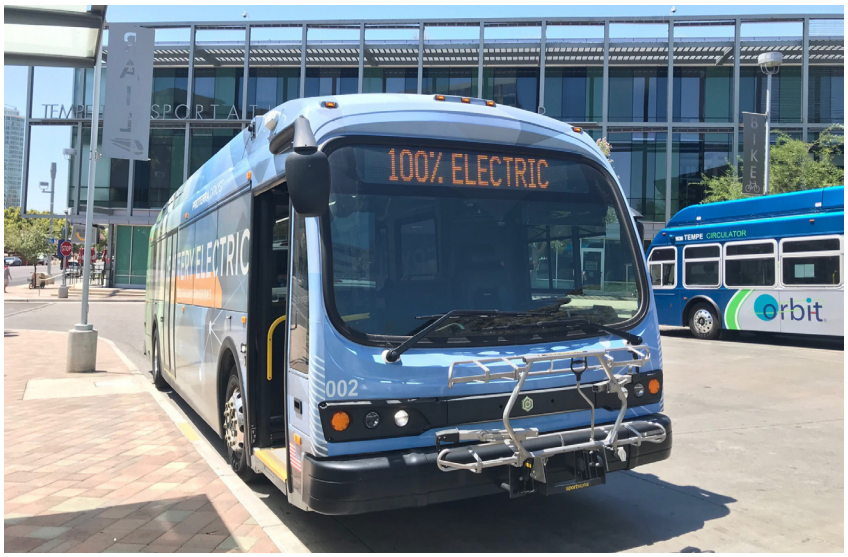
During the summer of 2020, Valley Metro tested battery electric buses (BEBs) from three different manufacturers on multiple urban, high density routes. Electric buses bring a number of environmental benefits, but historically, electric buses have been unsuccessful in the Phoenix Metro Area because the vehicles were unable to provide the range necessary for operating existing routes given the technology's adaptation to the region's climate. Battery electric buses use one battery to operate all functions of the bus, and the constant air conditioning demand present in hot climates cause the battery to deplete more quickly than it would in moderate climates. This was seen in 1994 during a pilot program in Phoenix and again in 2016 during an electric bus test in Tempe. Routes in the Phoenix Area span from 30 to 300 miles, with the majority of routes requiring over 100 daily miles per bus. Previous tests showed an electric bus's range to be under 100 miles, which would not support the needs of most routes unless in-route fast charging was used. The low range was an attribute of early electric bus technology and was exacerbated by the extreme heat in this region. In the past five years, electric buses have greatly increased their range and minimized battery impacts during extreme weather. With the improved battery electric bus, these vehicles may now be a viable option for select bus routes in the Phoenix Metro Area.

From August 4 through August 7, during a low of 83°F and a high of 112°F, the 35-foot Proterra Catalyst was tested on a Valley Metro circulator route. This vehicle had an average range of 152 miles under these test conditions, an estimated 185 mile range in 80°F and an estimated 209 mile range in 50°F. From September 22 to September 24, New Flyer tested their 35-foot Xcelsior CHARGE on the same route, with a high of 106°F and a low of 77°F. The New Flyer vehicle had an average range of 180 miles under the test conditions, an estimated range of 184 miles in 80°F and an estimated range of 192 miles in 50°F. Both the Proterra and New Flyer buses demonstrated the ability to operate the circulator route in all seasons without requiring in-route fast charging. The BYD bus was tested on a local bus route but experienced some operational issues which made it difficult to estimate range in various climates.

With improved battery technology, there is potential to utilize battery electric buses on some routes throughout the Greater Phoenix Area. The demonstrations and research has led Valley Metro to pursue an initial investment of battery electric buses. There are estimates that show BEBs have a similar or reduced total cost of ownership in comparison to traditional buses. Starting small would allow Valley Metro to gain operational and maintenance experience and help determine lifecycle costs of battery electric buses. Operating electric buses would also increase understanding of battery degradation, help set realistic expectations for BEB performance and contribute to the creation of attainable goals around BEB integration for the region. This report will further discuss the environmental benefits of electric buses in the Phoenix Metro Area, details of each bus demonstration, demonstration results, preliminary cost estimates and next steps.

1 PURPOSE OF REPORT

The purpose of the electric bus demonstrations is to determine if battery electric buses could operate in place of natural gas or diesel buses that currently operate on Valley Metro routes. While Valley Metro is looking at a variety of routes for electric buses, this study focuses on the FLASH circulator and Route 56. See Section 4 for details on these routes and justification for using these routes for demonstration purposes.



1: Proterra Catalyst Bus

To determine if electric buses could be an option for select routes, the project team needed to understand the expected range of an electric bus in hotter months. Battery electric buses currently have a shorter range than traditional buses, but range also varies depending on the following factors: climate, topography on routes, use of heater or HVAC units, number of passengers, and driver behavior. For the Phoenix Metro Area, the most applicable of these factors is air conditioning use in the summer. Because all systems within the bus are powered through the same battery, higher use of air conditioning will result in a faster battery drain; potential buses need to be tested during extreme temperatures to ensure that they are viable for the area of operation. Section 6 of this report discusses the ranges observed during the bus demonstrations.


2: Interior of BYD bus with water barrels

2 THE CASE FOR BATTERY ELECTRIC BUSES

2.1 Environmental Benefits

Carbon Emissions

One criticism of electric vehicles is that they are only as clean as the energy used to charge them. If an electric vehicle were charged with energy generated by coal power, the electric vehicle would in fact have more negative environmental impacts than a conventional car (Knobloch, 2020). Decades ago, this notion was true in many parts of the country, but as energy becomes increasingly cleaner in the United States, the electric vehicle becomes more sustainable.

As of 2018, battery electric buses have lower global warming emissions than natural gas and diesel-hybrid buses everywhere in the country. Assuming that a bus were charged with the national electricity mix , an electric bus would produce about 50 percent fewer carbon emissions than natural gas or diesel buses (UCSUSA, 2018). In Arizona, the energy sources to generate electricity are cleaner than the national average. The state relies heavily on natural gas and nuclear power, along with some renewables and a small amount of coal power (currently being phased out). With Arizona's current electricity mix, an electric bus produces 58 percent less carbon dioxide (CO2) emissions than a diesel bus and 52 percent less CO2 than a natural gas bus (UCSUSA, 2018).

Criteria Air Pollution

Battery electric buses eliminate criteria air pollution, which is a category of air pollutants that cause respiratory damage. Criteria air pollutants include particle pollution, ground-level ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead. The Clean Air Act requires the US Environmental Protection Agency to set National Ambient Air Quality Standards (NAAQS) for these pollutants. The criteria air pollutant that the Phoenix region has the most difficulty controlling is ozone. In Arizona, the primary source of ozone pollution comes from nitrogen oxides (NOx). As reported by the MAG Eight-Hour Ozone Moderate Area Plan for the Maricopa Nonattainment Area, there are 127 metric tons of NOx emitted each day and vehicle travel accounts for 49 percent of emissions. Natural gas and diesel hybrid buses emit fewer criteria air pollutants than diesel or gasoline buses, but BEBs are the only vehicles that produce no criteria pollutants. This makes electric vehicles a part of the solution to reducing the region's criteria air pollution.

Life Cycle Sustainability

The life cycle sustainability of electric buses is almost identical to natural gas or diesel buses. From a mechanical standpoint, electric buses have mostly the same parts as a traditional bus with the only significant difference being a battery to power the engine rather than internal fuel combustion. Most buses can be sold and/or salvaged at the end of life, but there are special considerations for disposing of an electric bus's battery.

Inside an electric bus, a series of lithium-ion batteries are strung together to form a battery pack that stores energy to power the vehicle. There are a few environmental concerns with lithium-ion batteries. The most prominent concern is the sourcing of lithium. While it can be argued that lithium mining is harmful to the developing world, it should be noted that the continued use of carbon emitting fuels has similar effects on international communities. Additionally, there are increasing efforts to increase equity in lithium mining. The other concern with lithium is recycling. Manufacturers are understandably secretive about what goes into their batteries, which makes it harder to recycle them properly. Furthermore, only some recycling facilities have the ability to recycle lithium batteries. For this reason, it has become standard practice for the manufacturers to take the batteries

[1] Energy mix of a country is the specific combination of different energy sources it uses to meet its energy consumption needs

[2] Life cycle sustainability analyzes the potential overall environmental impacts associated with all the stages of a product or service's life from the extraction of raw materials; the processing of raw materials in order to fabricate a product; the transportation and distribution of the product to the consumer; the use of the product by the consumer; to the disposal of the product's materials after its use.

back at the end of life to dispose of them on behalf of the client or repurpose them for energy storage. While no supply chain is perfect, there are efforts to increase equity in lithium mining, and the disposal of lithium batteries is improving as technology progresses.

Clean Charging

Arizona primarily generates electricity through natural gas and nuclear electric power. Coal was previously a large portion of this mix until Arizona's largest coal plant, the Navajo Generating Station, closed in December 2019. There is still some coal power used, but it is miniscule in comparison to what has been used historically. The remainder of Arizona's coal plants are planned to be phased out. Natural gas, motor gasoline, petroleum, and jet fuel provide most of the energy for the transportation sector (Energy Information Administration, 2018). Renewable energy (solar, wind, and hydropower) makes up about 10 percent of energy in Arizona. In November 2020, the Arizona Corporation Commission passed a proposal requiring utilities to be 100 percent carbon free by 2050 and meet particular benchmarks along the way. According to the commission, carbon free energy includes the following sources: solar, wind, hydroelectric, and nuclear. The following sources will be phased out for energy generation over the coming decades: coal, petroleum, natural gas, oil, and shale.

This is important to transit for three reasons. First, energy is relevant because transportation accounts for the highest energy use in the state. When looking at energy use by sector, transportation uses 36 percent of the state's energy, residential uses 27 percent, the commercial sector uses 23 percent and the industrial sector uses 15 percent (Energy Information Administration, 2018). The second reason that the energy transition is relevant is because a majority of Valley Metro's bus fleet runs on compressed natural gas. If the natural gas supply in Arizona were to significantly decrease or be unavailable, this would affect a large portion of the bus fleet. Lastly, this energy transition is important because it means operating battery electric buses would be more sustainable as time goes on. Given today's sources of electricity generation, electric buses are already more environmentally friendly than natural gas or diesel buses. As 2050 draws closer and energy from the grid becomes increasingly carbon-free, the electric bus will show tremendous environmental superiority in comparison to the natural gas and diesel bus.

2.2 Operational Benefits

Electric buses are the quietest type of transit bus, with some models being so quiet that they have to be equipped with noise emitters so passengers with visual disabilities can hear them coming. Electric buses are often associated with lower maintenance costs because there are fewer components inside the vehicles that need to be maintained. See Section 7 for more information on BEB maintenance costs.

2.3 Maricopa County Specific Benefits

Operating electric buses are a way for Valley Metro to support multiple city and county wide goals. At the city level, battery electric buses align with the City of Phoenix and City of Tempe's carbon reduction goals. It is anticipated that other cities will develop carbon reduction goals and operating electric buses would help cities move closer to their respective goals. Additionally, the operation of electric buses would improve air quality in a region that urgently needs cleaner air. The Phoenix Metro Area has been in non-attainment for federal air quality standards since 2008 and ranks lower than New York City in terms of air quality (Environment Arizona Research & Policy Center 2018). Additionally, the American Lung Association ranked the Phoenix area in 2011 as the 19th most ozone polluted cities in the U.S., with an unfavorable increase in 2016 to a ranking in the 4th spot (American Lung Association 2016, 2011). Operating electric buses would help the region move toward attainment of federal air quality standards.

3 PEER AGENCY ELECTRIC BUS PROGRAMS

Of the six agencies typically used by Valley Metro for peer comparison, five operate battery electric buses. In Arizona, both Sun Tran in Tucson and Mountain Line in Flagstaff are operating or planning operations for BEBs. Valley Metro conducted peer agency interviews to learn about the programs of each peer city. For the Arizona transit agencies, the information was obtained through informal conversations and publicly available information. This section will provide an outline of each of the agencies' programs.

Regional Transportation District (RTD) – Denver, Colorado

- Fleet of 36 BEBs that operate 3-mile route in eight-hour shifts
- Charging at bus depot
- Planning for addition of 17 BEBs
- First 36 buses were locally funded
- Second phase of project funded through VW Settlement ($11 million) and a Federal Transit Administration (FTA) grant ($2.6 million)

Utah Transit Authority (UTA) – Salt Lake City, Utah

- Fleet of seven BEBs that operate a 9-mile route
- Charging at bus depot
- Added BEBs to the fleet to diversify fuel mix and support environmental goals
- Estimated $9 million project with $5.4 million of funding from an FTA grant

Dallas Area Rapid Transit (DART) – Dallas, Texas

- Fleet of seven BEBs that operate a 9-mile route in 16-hour shifts
- Utilizes in route fast charging
- $9 million project with $7.6 million from an FTA grant

San Diego Metropolitan Transit System (MTS) – San Diego, California

- Fleet of eight BEBs that will be rotated and tested on all routes under 100 miles
- Fast charging at bus depot
- California transit is required to have 100% zero emission buses by 2040
- MTS will be adding more BEBs after testing
- $12 million project with $6 million funded through a state grant

TriMet – Portland, Oregon

- Fleet of nine BEBs that operate a 26-mile route and a 30-mile route in 18-hour shifts
- Overhead charging in route and slow charging at bus depot
- Planning to purchase 80 additional BEBs within six years
- Estimated over $65 million project with $50 million funded through State of Oregon and $7.7 million provided through FTA Low/No grants.

Sun Tran – Tucson, Arizona

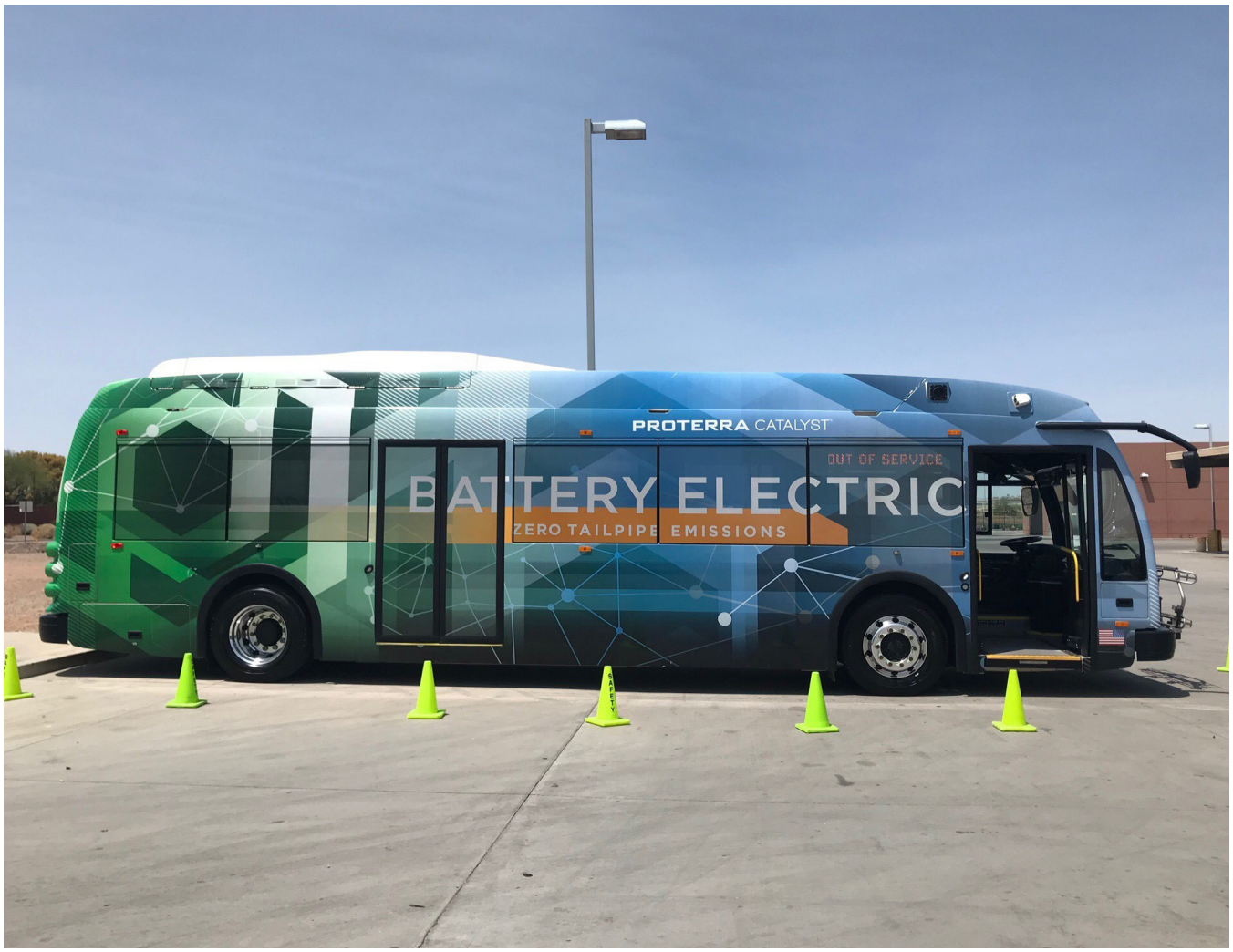
- Leased one Gillig bus in 2020 to test on different routes and has since purchased five BEBs to begin service in 2021 and five more to begin in 2022
- Slow charging at bus depot
- $4.8 million project: $3.76 federal share with $2.6 million from an FTA grant, $668,000 local match, $375,000 in-kind from Tucson Electric Power (TEP)

Mountain Line – Flagstaff, Arizona

- Developing a Zero Emissions Bus Transition Plan, which assesses zero emissions bus technologies specifically in the context of Flagstaff's location and climate and identifies the steps to transition to an all-electric fleet
- Received a grant for $17.3 million from the FTA for a downtown connection center and electric buses. $1.6 million of this funding is planned for purchasing two battery electric buses for testing (Arizona Daily Sun, 2019)

4 ABOUT THE DEMONSTRATION ROUTES

The FLASH circulator and Route 56 were used for the battery electric bus demonstrations. The Proterra and New Flyer 35-foot buses were demonstrated on the FLASH and the 40-foot BYD bus was demonstrated on Route 56. For the 35-foot buses, Valley Metro wanted to create similar demonstration conditions for a more accurate comparison between the two buses. The FLASH route was selected because it is a relatively shorter route in comparison to others in the region, its close proximity to the temporary charging stations set up at the Tempe bus yard, and the route was not operating in the summer of 2020, which made this route ideal for testing. Additionally, due to the COVID-19 pandemic, manufacturers were not allowing passengers to board demonstration buses. Route 56 was used to demonstrate the 40-foot BYD bus. Similarly, this route was selected because it has a shorter range in comparison to other routes in the region and because of the close proximity to temporary charging stations.



3: Proterra bus parked at the East Valley Bus Operations and Maintenance facility

5 BUS MANUFACTURERS AND DEMONSTRATIONS

A total of 10 days of testing were collectively performed between the three manufacturers – Proterra, BYD, and New Flyer, during the summer of 2020. Due to a variety of constraints, including construction impacts, COVID-19 related precautions, varying ambient temperatures and unique stipulations within each demonstration agreement, the parameters for each test varied slightly as noted below. Because of this, the performance of each vehicle should be compared with caution. Nonetheless, the demonstration was successful in ascertaining the general capabilities of each vehicle model to operate within the considered duty cycles.

5.1 BYD USA

About BYD USA

Build Your Dreams (BYD) USA is a battery technology company that manufactures a wide range of electric vehicles from forklifts to double decker buses. The company was founded in 1995 and has about 40,000 electric buses in service worldwide (BYD does not state how many of these operate in the US). One transit agency that operates BYD transit buses is RTD.

Demonstration

BYD provided their K9 model 40-foot bus for this demonstration. The demonstration occurred over a period of three consecutive days: August 26 – August 28. The high temperature during the demo was 113°F and the low was 89°F. The demonstration took place on Route 56 (Priest Drive) (Figure 1). This route was selected due to the variety of all-day and peak-time-only vehicle schedules, combined with the relatively close proximity to the East Valley Bus Operations and Maintenance Facility (EVBOM). Peak-only vehicle schedules were operated on days one and two, and an all-day vehicle schedule was operated on day three. The vehicle was operated only by BYD staff during the demo with no support from agency staff. A static load using 55-gallon water barrels was increasingly applied, between 0 barrels on day one and 14 barrels by day three. Slightly more weight was applied to this bus in comparison to the other test buses because BYD's bus was larger and Route 56 generally has higher ridership than the FLASH.

4: BYD demo bus

The vehicle operated morning and afternoon peak-time vehicle schedules on day one without incident, however an HVAC system failure was reported on day two and the bus returned to the facility early in the afternoon. The HVAC fault was unresolved by day three when the bus was dispatched to simulate the all-day block. Because the HVAC system was not operating at intended capacity and did not maintain an acceptable internal temperature following the reported failure on day two, the vehicle's energy efficiency and range data would need to be considered with caution as it is believed the HVAC system may have consumed less energy than typically expected while not operating at full capacity.

Figure 1: Route 56 for BYD Bus Testing

5.2 Proterra

About Proterra

Proterra is an electric bus company founded in 2004 that designs and manufacturers transit and school buses. As of October 2020, the company has 650 buses operating in the United States and 400 on order and planned for service. Some transit agencies that operate Proterra buses are DART, UTA, Tri-Met and King County Metro in Washington State.

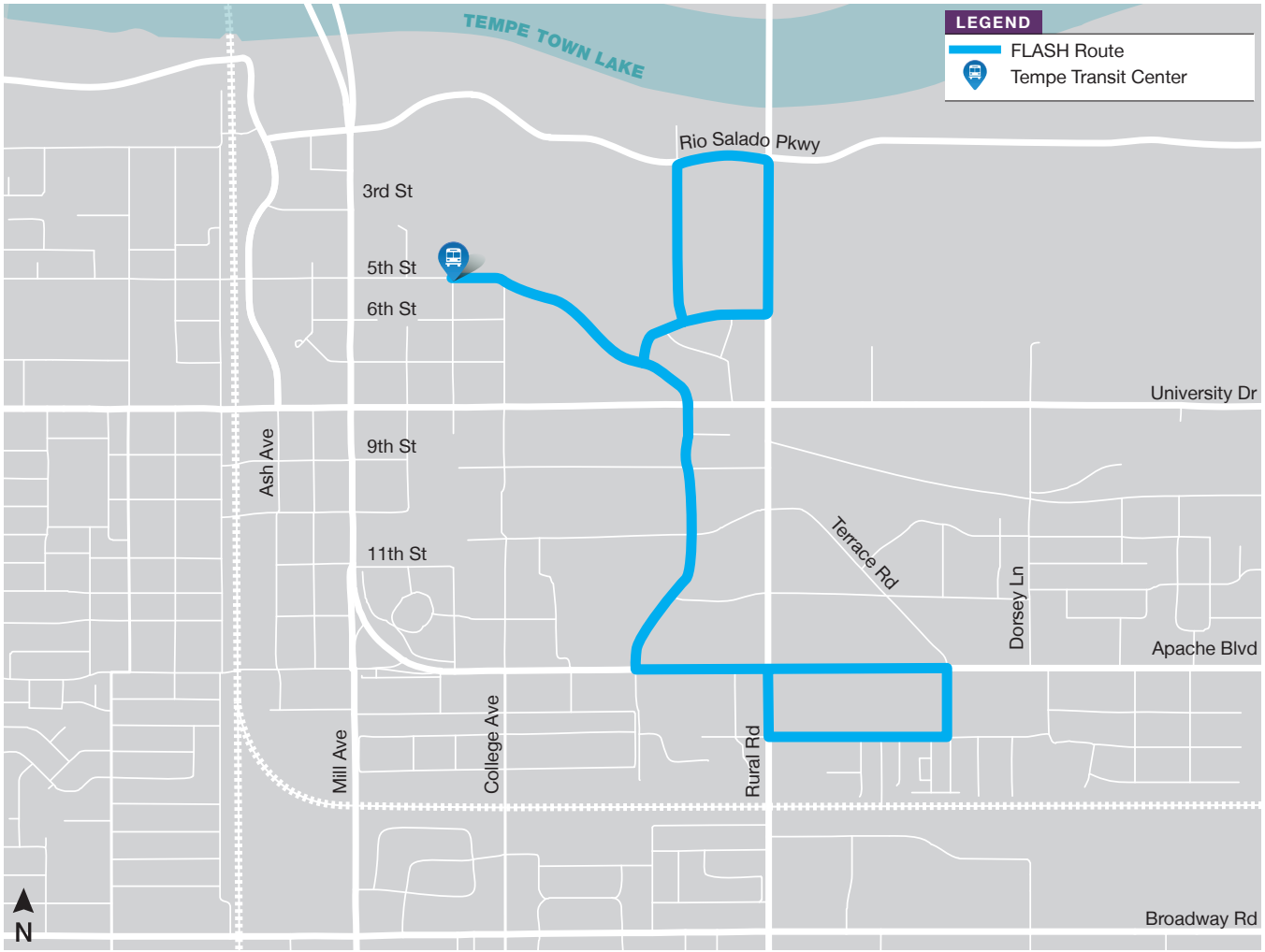
Demonstration

Proterra provided the first demonstration vehicle – the Proterra Catalyst 35-foot bus. The demonstration occurred over a period of four consecutive days: August 4th – August 7th. The high temperature during the demo was 112°F and the low was 83°F. A combination of Proterra staff and local agency staff operated the bus throughout the demonstration. The intent was to demonstrate the vehicle's capabilities when assigned to the FLASH service, however due to multiple construction projects along the regular FLASH route, a modified version of the route was developed. See Figure 2 for the route used during the demonstration. It should be noted that the route operated on days one and two was shorter in length than the route operated on days three and four, resulting in additional idle time and fewer miles-per-trip during the first two days compared to the final two days. A static load was applied to the vehicle incrementally throughout the test, using water-filled 55-gallon plastic barrels. On day one the vehicle operated with no load. On days two and three a partial load was applied using four of the barrels (approximately 2,000lbs or 13 passengers). On day four, a full load was applied using ten barrels (approximately 4,800lbs or 32 passengers). The vehicle pulled out of the yard later than expected on days two and four due to a charging issue attributed to the demonstration charger degrading during high ambient temperatures, requiring additional charge time. The vehicle itself performed without any mechanical faults or failures throughout the demonstration. At Proterra's request and to increase ventilation in response to the pandemic, the HVAC system was programmed to condition only fresh, outside air for the duration of the demonstration and it should be noted the HVAC system would work harder and draw more power when operating in this configuration, especially considering the high ambient summer temperatures.

5: Proterra demo bus

6: Interior of Proterra bus with water barrels

Figure 2: FLASH Route for Proterra Bus Testing



5.3 New Flyer

About New Flyer

New Flyer is a well-established bus manufacturer with a vast experience using multiple propulsion systems, including alternative fuels, electric and hybrid technology. There are 104 New Flyer electric buses in service in the United States and 237 buses on order to begin service in 2021 (data as of Q4, 2020). Some of the transit agencies that operate New Flyer battery electric buses are UTA, Tri-Met, San Diego Metropolitan Transit System, and LA Metro.

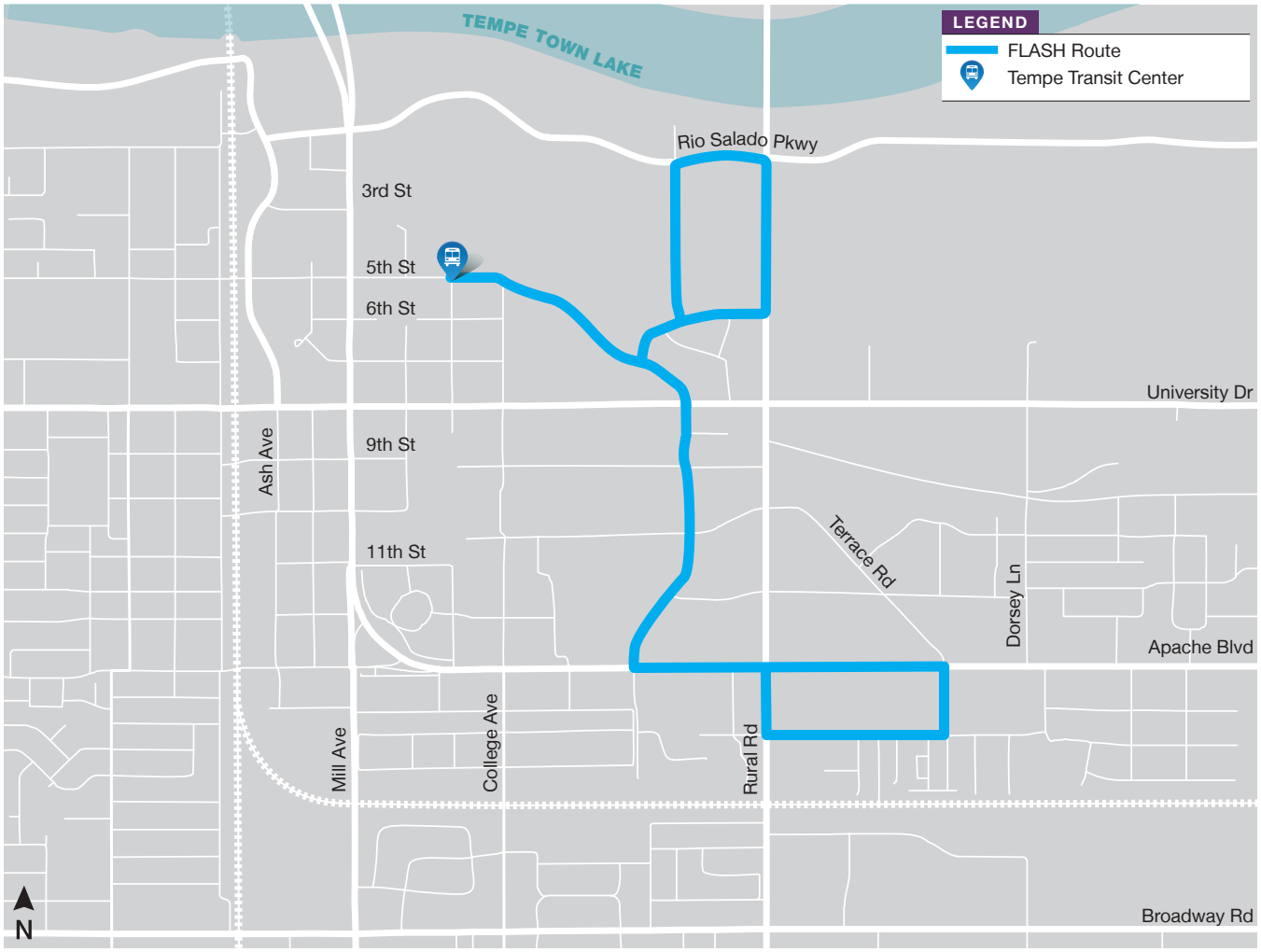
Demonstration

The third and final demonstration was performed in conjunction with bus manufacturer New Flyer, using the Xcelsior CHARGE 35-foot bus. The demonstration occurred over a period of three consecutive days: September 22nd – September 24th. The high temperature during the demo was 106°F and the low was 77°F. The vehicle was operated solely by New Flyer staff during the demo with no support from agency staff. The vehicle was operated on the regular FLASH route (no detours) throughout the duration of the

demonstration (Figure 3). A static load was applied to the vehicle prior to day 1 using 10 water-filled barrels (approximately 4,800lbs or 32 passengers), with the intent of removing part of the load for the remaining two days. However, late into the first day of demonstration, the vehicle experienced a battery fault in which one of the five battery strings was not properly connected, causing the bus to deplete the remaining four battery strings prematurely and without warning. As a result, the 10-barrel load remained on the bus for day two, and prior to beginning the third day of testing, six barrels were removed for a remaining four-barrel load (approximately 2,000lbs or 13 passengers). Aside from the mechanical failure observed on day one, the vehicle completed testing and was able to receive a charge effectively and as intended throughout the duration of the test.

7: New Flyer demo bus

Figure 3: FLASH Route for New Flyer Bus Testing



6 RESULTS

6.1 BYD USA

During the three-day demo there were multiple HVAC issues. The air conditioning unit inside the vehicle was not emitting cool air on day two or day three. The manufacturer attempted to repair the HVAC unit during the demo but was unable. It was discovered after the testing that the air conditioning unit did not have the proper freon levels and was therefore not able to effectively cool the bus. Because the HVAC issue could provide inaccurate range and efficiency data, the BYD demo results will not be included in this report because.

6.2 Proterra

Energy Consumption

The Proterra bus operated for four days and traveled a total of 406 miles. The average efficiency was 2.61 kilowatt-hours per mile, which is the equivalent of about 14.5 miles per gallon. 42 percent of the energy consumed powered the powertrain, 41 percent powered the HVAC unit, and the remaining energy powered low voltage equipment, the air compressor, and power steering.

Range

The vehicle's maximum range under the test circumstances was 152 miles. Given the air circulation COVID-19 protocols in place, this is a conservative representation of the vehicle's ability to perform. If the air was being recirculated like it is in normal operating conditions, the range would have been greater than 152 miles.

Air Conditioning

The bus maintained an average internal temperature of 74 degrees when outside temperatures averaged 106 degrees and the bus was consistently bringing in outside air. Three different Valley Metro staff rode the bus and assessed the thermal comfort of the vehicle, and all three staff members felt that the air conditioning was adequate. Air conditioning use accounted for 41 percent of battery usage.

Charging

The bus experienced some difficulty charging because of the placement of the temporary charging infrastructure. The charger used during the demo was a shop charger designed to be used indoors where there is a controlled climate. As such, the charger is not weatherproof, and had only been designed to operate at full output up to 104°F. The charger was placed in full sun at the Tempe bus yard, and the heat caused the charger to degrade and charge the bus slower than expected. If using a permanently installed charger, the bus is estimated to charge in as little as 1.8 hours.

Rider and Operator Feedback:

Below is some of the feedback gathered from Valley Metro staff that rode the Proterra bus:

- "Bus is quieter than others at the Tempe Transit Center"
- "Good acceleration, turning, and braking"
- "Ride quality is about the same as current buses"

One First Transit operator drove this bus during the demonstration. The operator noted that they liked the brakes, acceleration, and that the operator seating area had slightly more room than other buses. The operator enjoyed driving the bus and supports the purchase of this bus.

6.3 New Flyer

Energy Consumption

The New Flyer bus operated for two days and traveled a total of 240 miles. The average efficiency was 2.0 kilowatt-hours per mile, which is the equivalent of about 16.9 miles per gallon. 60 percent of the energy consumed powered the powertrain, 26 percent powered the HVAC unit, and the remaining energy powered low voltage equipment, the air compressor, and power steering.

Range

The vehicle's maximum range under the test circumstances was 181 miles.

8: Proterra bus parked at the East Valley Bus Operations and Maintenance facility

Air Conditioning

This bus was not equipped with the same sensors as the Proterra bus. The HVAC was set to 68 degrees through the duration of the demo but the average temperature inside the bus was not recorded. Three different Valley Metro staff rode the bus and assessed the thermal comfort of the vehicle, and all three staff members felt that the air conditioning was adequate and comparable to the Proterra bus. Air conditioning use accounted for 26 percent of battery usage.

Charging

The bus took two hours to go from a five percent to a 95 percent charge.

Rider and Operator Feedback

Valley Metro staff that rode this bus noted that this was the quietest bus tested. No First Transit operators drove this bus during the demo.

6.4 Comparing Proterra and New Flyer Demonstration Vehicles

HVAC Performance

From a qualitative perspective, the air conditioning on both the Proterra and New Flyer buses were adequate. Multiple staff members rode the buses to assess comfort, and employees noted that the air conditioning inside the vehicles felt comparable to the natural gas buses presently used. The Proterra bus was equipped with a sensor that monitored the internal temperature throughout the service day, but the New Flyer bus only recorded data on the set point of the HVAC system.

It is difficult to compare the HVAC systems in a BEB and a natural gas or diesel bus because the mechanical design and operating characteristics are significantly different. Comparing output specifications, the rated cooling capacity of the natural gas bus HVAC unit is higher than the rated cooling capacity of the BEB; New Flyer indicates the HVAC cooling capacity of the BEB is 72,000 BTU/hr., whereas the HVAC cooling capacity of the standard natural gas bus is 105,000 BTU/hr. However, this comparison is somewhat misleading because the actual performance of the standard natural gas bus HVAC unit at any given time is dependent on vehicle speed, or more specifically engine speed. The BEB HVAC unit specifically eliminates this problem, by "eliminating the effect of variable engine RPM on load and demand" and provides "Optimum A/C unit capacity at all bus speeds" (Thermo King brochure provided by New Flyer, 11/20). The HVAC system cooling performance as observed during the testing period was effective, and the vehicle remained at a comfortable and acceptable interior temperature when observed by staff.

Battery Performance

Table 1 depicts the performance of the Proterra and New Flyer buses during their demonstrations. It can be seen that the New Flyer bus displayed higher battery efficiency, longer range and longer operation time—however the bus was tested under less difficult conditions than the Proterra bus.

Tables 2-4 show the expected range and efficiencies of the vehicles at different temperatures based on the data collected during the demonstrations. A key takeaway from this data is that the Proterra bus has the potential for a longer range but shows a higher range variability depending on climate. On the other hand, the New Flyer bus shows a lower range in moderate climate conditions, but the bus maintains a more consistent range as the weather changes. The New Flyer bus also demonstrated a longer range in the summer, however the HVAC differences explained earlier should be taken into consideration. The Proterra bus ranges from 152 miles in 112°F to 209 miles in 50°F, while the New Flyer bus ranges from 160 miles in 112°F and 192 miles in 50°F.

Table 1: Performance Results of Summer 2020 Bus Testing

BUS	AVG TEMPERATURE DURING SERVICE DAY (°F)	AVG EFFICIENCY IN KWH/MI	MPG EQUIVALENT DESCRIPTION	MAXIMUM RANGE	MAXIMUM TIME OF OPERATION
Proterra 35-foot E2	105.5	2.6	15	152	19:43
New Flyer 35-foot Xcelsior CHARGE	98.7	2.0	19	181	20:30

Table 2: Modeled Bus Performance in 112°F

BUS	AVG EFFICIENCY IN KWH/MI	MPG EQUIVALENT	MAXIMUM RANGE
Proterra 35-foot E2	2.6	15	152
New Flyer 35-foot Xcelsior CHARGE	2.4	16	160

Table 3: Modeled Bus Performance in 80°F

BUS	AVG EFFICIENCY IN KWH/MI	MPG EQUIVALENT	MAXIMUM RANGE
Proterra 35-foot E2	2.2	17	185
New Flyer 35-foot Xcelsior CHARGE	2.1	18	184

Table 4: Modeled Bus Performance in 50°F

BUS	AVG EFFICIENCY IN KWH/MI	MPG EQUIVALENT	MAXIMUM RANGE
Proterra 35-foot E2	2.0	19	209
New Flyer 35-foot Xcelsior CHARGE	2.0	19	192

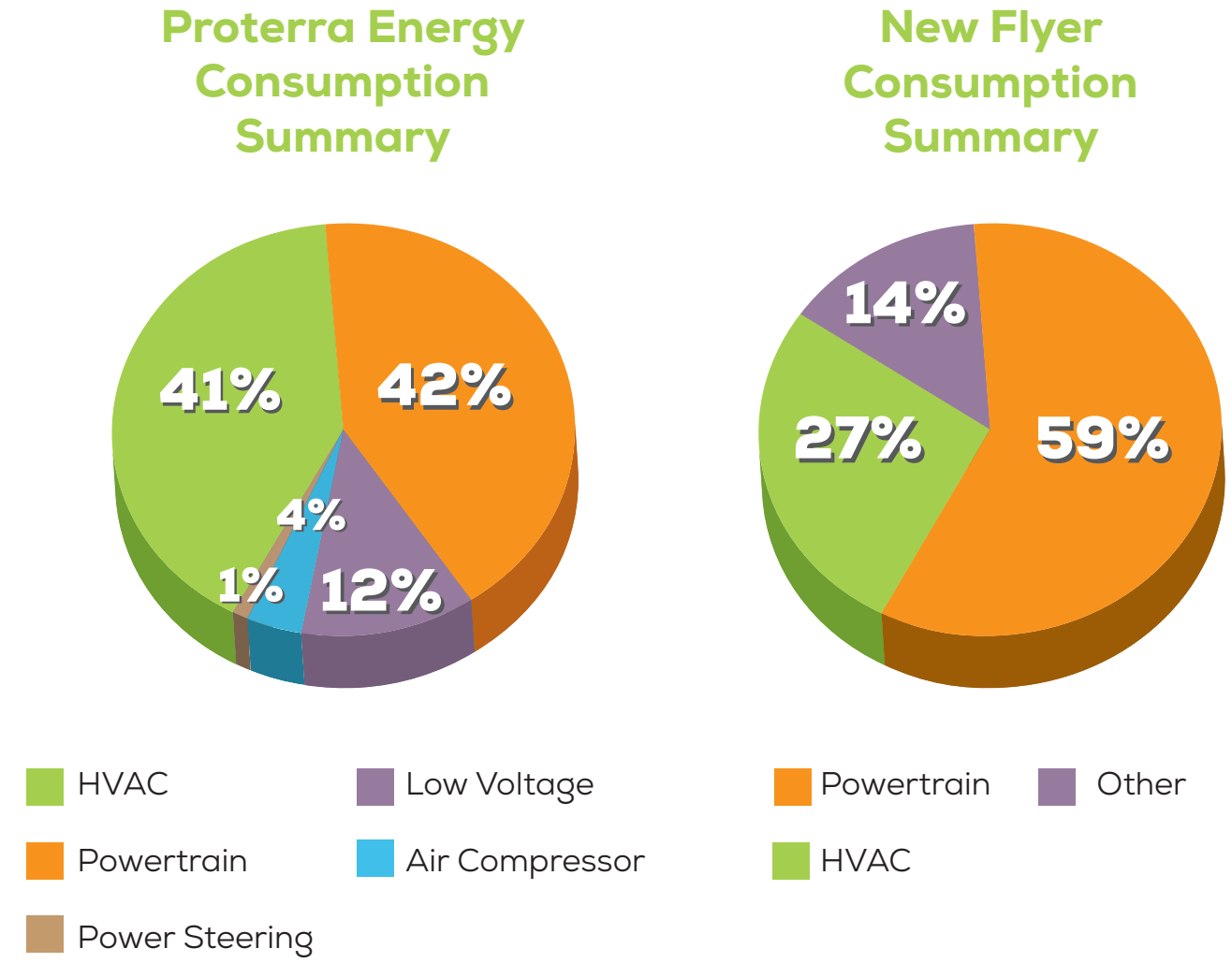
Planning for Battery Degradation

During the New Flyer demonstration, the electric bus demonstrated an energy efficiency of 2.0 kilowatt-hours per mile. The 35-foot New Flyer electric bus is available with a 437kWh battery capacity in comparison to the 400 kWh bus demonstrated during the summer (New Flyer, 2020). In new condition, the 437kWh vehicle would be expected to operate up to 219 miles during the summer. New Flyer considers the end-of-life capacity to be 70 percent, or 306 kWh. 70 percent of battery capacity would bring the expected range to 153 miles. The standard New Flyer warranty that is included with the purchase of each vehicle guarantees 70 percent for six years. Purchasing the extended warranty would guarantee 70 percent for 12 years or 500,000 miles.

During the Proterra demonstration, the electric bus demonstrated an energy efficiency of 2.6 kilowatt-hours per mile. The Proterra electric bus is available with a 440 kWh battery capacity (Proterra, 2020). In new condition, the vehicle would be expected to operate up to 152 miles during the summer. Proterra warrants their batteries for 12 years and guarantees 70 kWh per every 110 kWh, or 64 percent of usable battery power. Proterra also offers an extended warranty on the battery that guarantees 80 percent of battery capacity for 12 years. At the end-of-life with no extended warranty, the expected range would be 97 miles; with the extended warranty, the range would be 122 miles. When looking at this end of life range, it is important to note the harsher conditions that the Proterra vehicle was tested in and consider this range as a worst-case-scenario. Another aspect to consider is the differences between how New Flyer and Proterra advertise battery capacity. Proterra indicated that 90 percent of their advertised battery capacity is usable, whereas New Flyer simply indicates that the batteries have a usable capacity of 440 kWh. With this in mind, the Proterra numbers are lower and New Flyer has a new battery with a higher capacity rating.

Figure 4 compares the battery usage between the Proterra and New Flyer buses during their respective demonstrations. The biggest difference between the two buses can be seen in the energy used to power the HVAC system. The Proterra bus used 41 percent of the battery to power the HVAC system while the New Flyer bus used 27 percent of its battery power.

Figure 4: Battery Consumption by Category



7 BATTERY ELECTRIC BUS COST ESTIMATES

Vehicle

Battery electric buses have a higher upfront cost when compared to natural gas or diesel buses. Depending on specifications, a New Flyer electric bus ranges from $800,000 to $850,000 (as of Q4 2020). Similarly, a Proterra bus ranges from $739,000 to $850,000 (as of Q4 2020). In comparison, a standard 35-foot natural gas bus costs approximately $560,000 in 2020 dollars.

Charging Infrastructure

The initial electric bus investment would utilize slow charging at the bus depot to charge buses overnight, with one charging station for each bus. The total charging infrastructure costs per vehicle is estimated to be $200,000. The charging station itself is estimated at $75,000 per charger and engineering, design and installation are estimated at $125,000 per charging station.

Charging Costs

Charging costs could vary depending on the location used for charging the buses. In order to determine more accurate costs, Valley Metro would need to pick a facility for charging station installation and start working with the respective utility provider. It is difficult to give an accurate estimate at this time.

Maintenance Costs

Valley Metro's current internal combustion circulators have a per vehicle average maintenance cost of $0.39/mi and a maintenance cost range of $0.20/mi to $0.71/mi. The per vehicle estimated maintenance cost for the Proterra and New Flyer BEB's is between $0.20 and $0.40 per mile (Proterra and New Flyer estimates as of Q4, 2020). The electric bus cost per mile estimate does not include replacing the battery. While replacing a battery is the most expensive potential maintenance, depending on the duty cycle of the bus it is not always necessary. If a route similar to the test route were run with electric buses, it is not expected that Valley Metro would need to replace the battery. The cost to replace the battery is estimated to be $200,000. This cost can be covered by purchasing an extended warranty from the electric bus manufacturer. The likelihood of batter replacement and its impact maintenance costs would need to be evaluated on a route by route basis.

Training

Both Proterra and New Flyer include some mechanic training for electric buses. Special tools and training (including ongoing recertification training) would be required for the maintenance of high-voltage systems present on all electric buses demonstrated to-date. Valley Metro has historically acquired special equipment/tooling as part of the bus procurement (which is beneficial due to the availability of federal funding for bus purchases) and some initial training hours. However, the service contractor would be ultimately responsible for ensuring all staff maintaining the electric buses are trained and certified to work on the equipment. Training would also be required to coordinate vehicle charging as needed, including oversight of nightly charging as part of an optimized charging strategy.

Warranties

Proterra and New Flyer electric buses have standard and extended warranty options available for various components of the buses. Proterra's standard warranty that is included in the base price covers the following components outlined in Table 5. In addition to the standard warranty, Proterra offers extended warranty options for their buses. Considering Valley Metro's routes, the 12 Year Energy Storage System Warranty is recommended. This would ensure that 80 percent of the battery capacity would be usable for the lifetime of the vehicle, in comparison to just 64 percent from the standard warranty. This extended warranty is estimated to cost $75,000 per bus. It is not anticipated that the other warranty options would be necessary.

Table 5: Proterra Base Warranty Standard Terms

COMPONENT	YEARS	MILES
Complete bus	1	50,000
Main composite monocoque structure	12	500,000
Structural system	3	150,000
Major components	2	100,000
Energy storage systems	6	300,000
Charging systems	2	N/A

Like Proterra, New Flyer has a standard warranty that is included with each bus and extended warranty options that can be purchased for different components of the vehicle. **Table 6** shows the standard terms of the base warranty.

Table 6: New Flyer Base Warranty Standard Terms

MAJOR COMPONENT DESCRIPTION	YEARS	MILES
Base Bus Warranty	1	50,000
Basic Bus Structure	3	150,000
Chassis Structure (Integrity)	12	500,000
Chassis Structure (Corrosion)	12	500,000
Propulsion System	6	300,000
Energy Storage System	6	300,000
Axle (front and rear)	5	300,000
A/C	2	Unlimited
Brake System	1	50,000
Destination Signs	6	Unlimited
Door Systems	3	150,000
Wheelchair Ramp	2	Unlimited
Electrical System	3	150,000
Tires	2	24,000
LED Headlights	6	Unlimited
Air Compressor	1	Unlimited
New Flyer Connect System	2	Unlimited
Paint	5	Unlimited

While extended warranties can be purchased for a variety of components, the project team anticipates that the battery storage system warranty would be the only extended warranty needed. This warranty will ensure the bus will maintain 70 percent of battery capacity through the 12-year life of the bus. Purchasing this warranty is estimated to cost $55,000 per bus.

Table 7 summarizes the cost estimates listed above to show the anticipated initial cost for procuring a battery electric bus. The estimate assumes the higher warranty cost of $75,000.

Table 7: Battery Electric Bus Initial Cost Estimate

ITEM	QUANTITY	COST PER UNIT	TOTAL
Bus	1	$800,000	$800,000
Charger	1	$125,000	$125,000
Charger Installation	1	$75,000	$75,000
Warranty	1	$75,000	$75,000
		Total Initial Cost	**$1,075,000**

8 NEXT STEPS

After multiple electric bus demonstrations during the summer of 2020, it is apparent that electric bus technology is rapidly evolving and is becoming a more viable option for regions with hot climates. An initial investment of battery electric buses would further knowledge of the technology in our region and bring numerous environmental benefits to the community. There is also the potential for cost savings through the life of the bus. In order to bring electric buses into service in the region, the project team has identified the following as critical next steps.

- Coordinate with Utility Providers. The cost to charge the vehicles has a large impact in the overall cost to operate electric buses. When transit agencies work closely with their electric providers, they are able to create charging schedules that benefit both the utility and the transit agency.
- Determine Battery Electric Bus Manufacturer. New Flyer and Proterra demonstrated the ability to be able to operate shorter range routes during peak climatic conditions. Some additional research should be done to determine which bus would best suit Valley Metro's needs and determine the exact costs associated with each bus manufacturer. Makes and models of electric buses that entered the market after the summer 2020 testing should also be considered.
- Seek Funding Opportunities. There are a variety of grant programs that support transitions to electric vehicles. Valley Metro should begin researching and applying for funding opportunities to support the upfront cost of electric buses and the electric charging infrastructure.

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Fare Collection System Modernization Project

Tempe Transportation Commission
September 14, 2021

Fare Collection System Modernization

- **Regional Approach**
- **Project Goals**
  1. Improved Fare Payment Options for Customers
  2. Improved Data Collection and Ridership/Revenue Reconciliation
  3. Increased Control Over Media Distribution and Reduced Fare Programs
  4. Explore Longer Term Alternatives with Phased Implementation

Fare Collection Procurements

Current Scope	Phoenix Procurement	Valley Metro Procurement
TVMs	X	
Validators	X	
Public Smartcard	X	
Mobile App	X	
Websites	X	
Retail Network		X
Additional Scope		
Customer Service		X

Awarded to **Vix Technology**, March 2020, $61.2M

Awards

Retail Network – **Incomm**

Customer Service – **Vix Technology**

Phoenix Contract Details

Base Contract

- Maximum cost $33.2 million (Capital)
  - FTA – 80%
  - Prop. 400 – 20%
- 3 years: installation period
- 1 year: warranty and hosting agreement

Operation and Maintenance Support

- Maximum cost $28.0 million
  - Prop. 400 & local funds
- 9 years initial agreement
- Two optional three-year extensions

Project costs shared by the City of Phoenix, Valley Metro and regional partners

City of Phoenix
PUBLIC TRANSIT DEPARTMENT

VALLEY METRO

Federal Transit Administration

Valley Metro Contract Details

Call Center

Base Contract

- 5 Years, $9.5M

Options

- #1 – 3 Years, $7.3M
- #2 – 2 Years, $5.2M

Total Contract - $22M

Funding Source

- Prop 400

Retail Network

Base Contract

- 5 Years $4.5M

Options

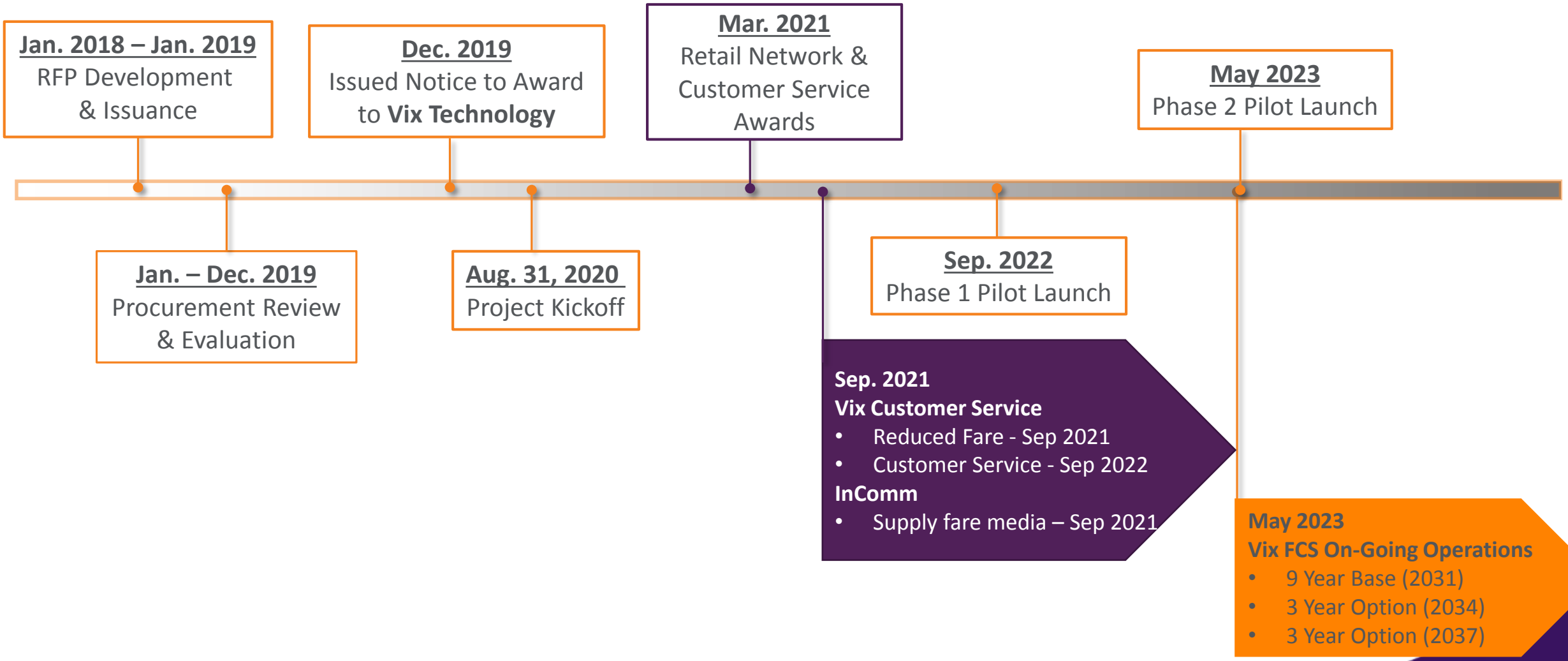
- #1 – 3 Years, $3.2M
- #2 – 2 Years, $1.6M

Total Contract - $9M

Funding Source

- Prop 400, Passengers

Project Timeline



New Features and Equipment

- **New Fare Options**
  - Mobile ticketing
  - Reloadable smart cards
  - Retail network
  - Innovative fares (“fare capping”)
  - Web-based fare purchases and account management

- **New validators and Ticket Vending Machines (TVMs)**

Rendering of new touchscreen ticket vending machine

Phasing of Features

Phase 1 – Validators and Mobile Ticketing

- Gives transit users the ability to manage their account via phone app or web browser
- Validators installed on bus and rail systems

Phase 2 – Reloadable Smartcard & TVMs

- Pre-phase 2: Reduced fare ID outreach & applications
- Reloadable smartcard availability to all transit users, with ability to purchase and load fare online
- Validate on both bus and rail
- Installation of new Ticket Vending Machines (TVMs)

Retail Network Services

Retail Network - InComm

- Full service contract
  - Reloadable smartcard distribution, replenishment, management of retailers, revenue management
  - Sell full-fare cards only, reload value on all categories
- Fare media supplier to region
- Replaces existing Retail Network managed by City of Phoenix

Benefits

- Lower costs to region in long term
  - Each smartcard can last up to 10 years
- Simplified fare media distribution for customer
  - Just grab card, add value
- Lower risk
  - No value on cards until sold

Call Center

Customer Service – Vix Technology

- Comprehensive customer service for new Fare Collection System
- Reduced fare application processing, reduced fare roll-out
- Smartcard account inquiries, claim investigation, refund processing, adding stored value, mobile app accounts

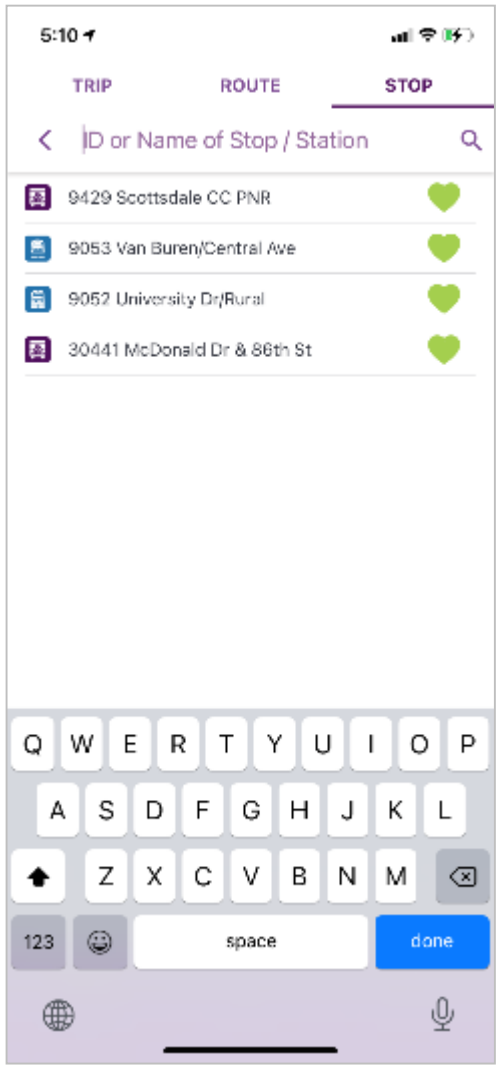
Benefits

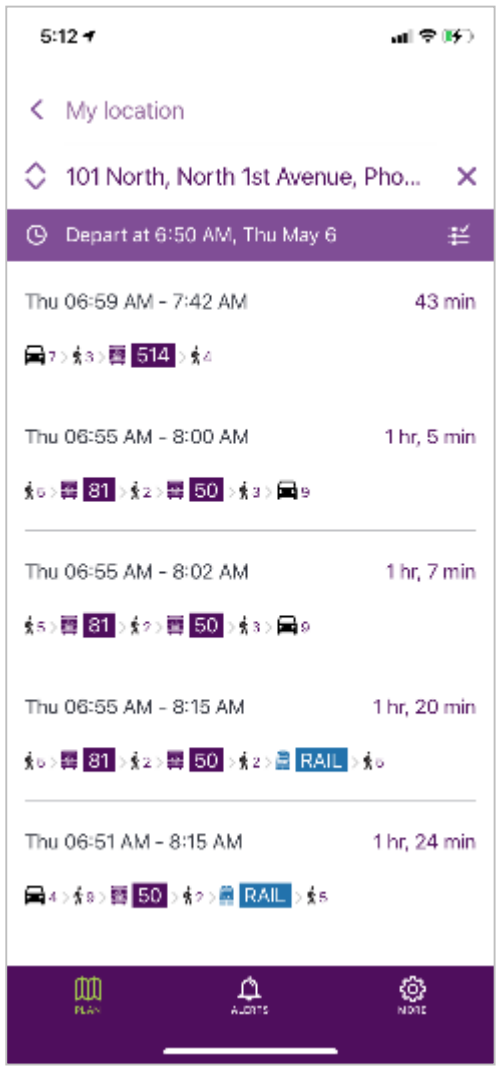
- Industry best-practice to outsource for this type of system launch
- Vix is also vendor for regional fare collection system and software
- Contract flexibility to pull resources in/out as needed for peak periods

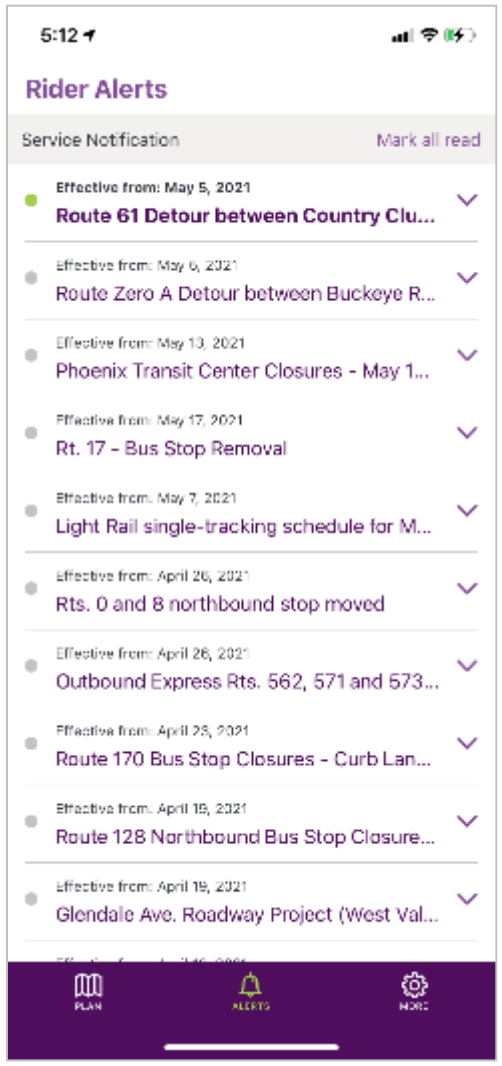
Mobile App Phasing

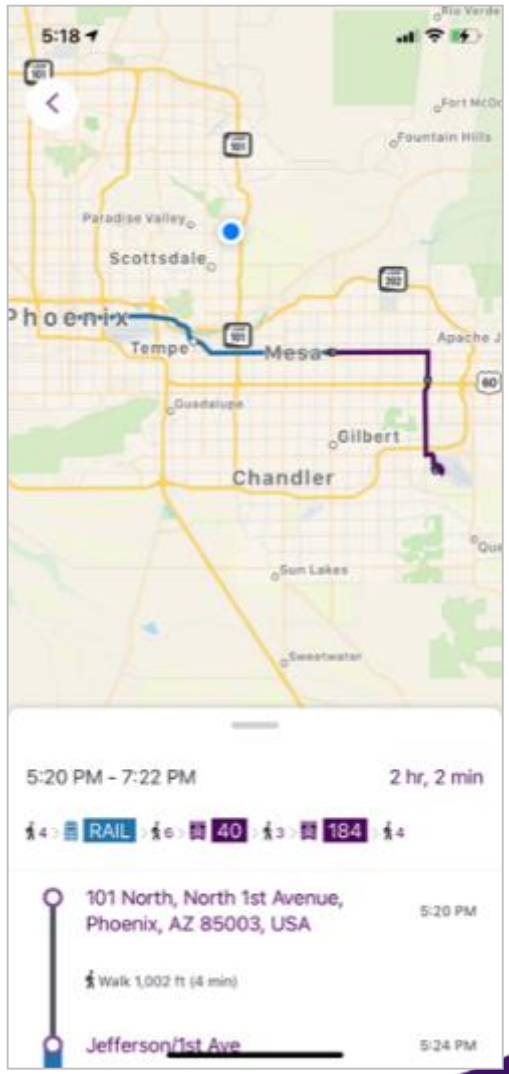
- **Expedited Mobile App – July 2021**
  - Rider Alerts, Real-time vehicle location
    - Over 4,800 Downloads since July 1st
- **Phase I Launch – September 2022**
  - Limited passes offered – full fare one ride and day pass
- **Phase II Launch – May 2023**
  - Full functionality – all fare options available

Expedited Mobile App









Hardware

- **Future System will be heavily reliant on Validators**
  - TVMs will be scaled back from 4 to 2 per platform
  - Minimum of 2 validators per station, however up to 6 in some locations
  - One validator per bus

Tempe Streetcar

- **Customized solution for streetcar**
  - New Mode, New Experience
  - Planning to incorporate new fare collection technologies
- **Free fares for limited period**
- **Validators on-board**
  - 2 per vehicle
  - Mobile ticketing and smart cards
- **Simplified ticket dispensing at platforms**
  - Lower up-front cost and smaller footprint
  - Convenient option for cash-paying passengers, visitors/special events

Key Project Milestones

• Expedited mobile app	July 2021
• Mobile ticketing launch (Phase I)	Sep 2022
• Smartcard launch (Phase II)	May 2023

Questions

MEMORANDUM

TO: Transportation Commission
FROM: Braden Kay, Sustainability Director
DATE: September 14, 2021
SUBJECT: Climate Action Plan 2021 Update

The Sustainability Office is working to complete the 2021 Update. After completing Tempe's first Climate Action Plan in 2019, there is an opportunity to add more resident and business perspectives into the city's climate action work.

The Update will include stakeholder specific agendas:

- Business (Led by Tempe Chamber of Commerce and Local First Arizona)
- Climate Justice (Led by Unlimited Potential)
- Youth (Led by Office of Sustainability)
- Neighborhoods (Led by Office of Sustainability)

These agendas allow these stakeholder groups to articulate their own needs and actions that they want to move forward in the City of Tempe.

The CAP 2021 Update will also include updates on Tempe's carbon reporting, progress on the actions from the 2019 plan, and progress on the city operations climate action implementation.

The Sustainability Office will return later this Fall to ask for a letter of support for the CAP Update. September's presentation is to provide context and review the four agendas.

Please feel free to email Braden Kay at braden_kay@tempe.gov with any questions, comments, or feedback.

Climate Action Plan 2021 Update
Virtual Meeting

Four Agendas: Youth, Neighborhoods, Businesses, Climate Justice

September 14, 2021

Tempe

Making waves in the desert

Land Acknowledgement

We wish to acknowledge that Tempe is the homeland of the Native people who have inhabited this landscape since time immemorial. Anthropological studies document large and advanced Ancestral O'Odham settlements located throughout the entirety of present-day Tempe and recognize the ancestral lands of the O'Odham (known as the Pima), Piipaash (known as the Maricopa), and their ancestors as extending far beyond our community. This land continues to be spiritually connected to the O'Odham of the Salt River Pima-Maricopa Indian Community and Gila River Indian Community. The SRP-MIC and GRIC, located northeast and south of Tempe, respectively, are confederations of two unique groups with their own languages, customs, cultures, religions, and histories; the O'Odham and the Piipaash. Both the O'Odham and the Piipaash are oral history cultures.

The landscape is sacred to the O'Odham and Piipaash and reflects cultural values that are central to their way of life and their self-definition. Their oral history and song culture are indelibly tied to tangible places that are associated with specific historic, cultural, and religious values. Settlement patterns, advanced irrigation practices, and other lifeways driven by a deep understanding of and respect for the landscape are directly attributable to the ancestors of the O'Odham and Piipaash and served as the template for the establishment of Tempe. We accept the responsibility of stewarding those places and solemnly pledge to consider this commitment in every action.

- **City of Tempe Mayor and Council approved resolution, Jan 2021**

Schedule

Time	Agenda Item
12:00-12:10 p.m.	Introduction
12:10-12:30 p.m.	Businesses Agenda & Q&A
12:30-12:35 p.m.	Neighborhoods Agenda
12:35-12:40 p.m.	Climate Justice Agenda
12:45-12:50 p.m.	Youth Agenda
12:50-12:55 p.m.	Q&A
12:55-1:00 p.m.	Conclusion

Tempe

Climate Action Plan (CAP)

- A CAP is a policy document that focuses on reducing cities' greenhouse gas emissions and adapting cities to be resilient to future climate changes.
- The City of Tempe uses our CAP as a guideline for prioritizing actions and achieving the most cost-effective solutions in conjunction with other city goals and priorities.
- The CAP helps to develop strategies to conserve resources and make quality of life improvements.

CLIMATE ACTION PLAN

Tempe

CAP 2021 Agendas Overview

- Businesses, Neighborhoods, Youth, Climate Justice Agendas
  - Actions
  - Partnerships
  - Highlight Actions

BUSINESS AGENDA

Who: Tempe Chamber of Commerce, Local First Arizona, Tempe Businesses

Engagement: Climate Action Plan Business Forums (June 29 and July 14, 2021)

Purpose: To provide a space for Tempe business leaders to share their thoughts, advice, and ideas with the City of Tempe regarding the business agenda for the Climate Action Plan 2021 Update.

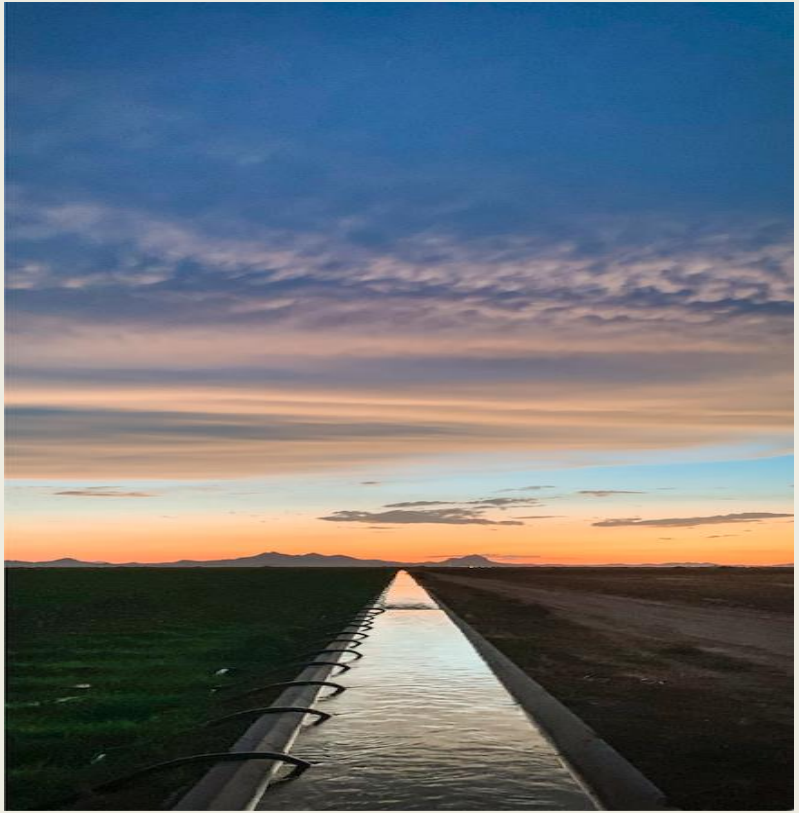
Actions

1. Energy Efficiency
    - Reduce GHG emissions and save money
    - Cost savings practices to grow green economy
    - Energy, SRP or APS, Utility Programs for Businesses
        - Rebate programs
        - Retrocommissioning programs
        - Small business programs training
        - Energy audits/assessment

Actions

2. Water Conservation

- Reduce water insecurity
- Invest in green infrastructure
- Water Utilities Division Commercial Industrial and Institutional (CII) Program for Businesses
  - Best management practice
  - WaterSmart Portal
  - Commercial Grants and Rebates
  - Industrial Grant



Tempe Chamber of Commerce

City of
Tempe

Local First
Arizona

PARTNERSHIPS

Partnerships

Barriers to Participating

- Lack of relationships/contacts
- Lack of knowledge
- Access to capital

Main Reasons for Being Invested

- Environmental stewardship
- Social responsibility

Partnerships Provide

- Access to best practices
- Accountability structure
- Support team

Motivation to Partner

- More access to experts and information
- Resource guide
- Best practices webinars

Highlight Action

Mobility Hubs

Highlight Action

Mobility Hubs

Culdesac

- First car-free neighborhood in the U.S.
- Development on a 17-acre lot in Tempe
- Made up of residential and retail space
- Will provide transportation solutions for residents and visitors
- Beneficial for businesses

Neighborhoods Agenda

Who: Tempe Neighborhoods and Community Members

Engagement: Climate Action Plan Neighborhood/Community Forum (June 22, 2021)

Purpose: To provide an open space for Tempe residents to share their thoughts, advice, and lived experiences with the City of Tempe regarding the neighborhood agenda.

Neighborhoods Agenda - Action

Resilience to Extreme Heat

- Programs
  - 100% bus shelter coverage
  - Community Cooling Centers/Resilient Energy Hubs
  - Increased tree canopy across the city
  - Installation of Permeable Pavement

Neighborhoods Agenda - Action

Resilience to Extreme Heat

- Equity
  - Affordable electricity
    - subsidize energy costs
  - Ensure availability of energy
  - Rebates for solar panel installation
  - Hold utilities accountable for a transition to renewable energy
  - Build social capital and focus on community-led solutions
  - Provide services for people experiencing homelessness to seek shelter

Neighborhoods Agenda - Partnerships

Community-Based Organizations

Equity in Extreme Heat

- Invest more in equitable transportation infrastructure improvements
- Improve infrastructure and accessibility for people with physical and mental disabilities
- Focus on overall infrastructure improvements for public transportation
- Address health concerns associated with long waits for public transportation and lack of air conditioning
- Install buttons for emergency services and on-demand transportation at bus shelters
- Install buttons for emergency services and on-demand transportation at bus shelters

Neighborhoods Agenda - Partnerships

Equity in Extreme Heat:

- Increase connectivity between neighborhoods, businesses, schools, and other public spaces
- Ensure that every child in Tempe can safely walk or bike to school
- Design and implement programs that disseminate emergency packs (including water, electrolytes, food, toiletries, and other necessities), to communities and individuals in need.
- Address energy and water equity through reducing or completely eliminating the cost of water and electricity
- Increase the availability of Green Jobs

Neighborhoods Agenda - Highlight Actions

1. Resilient Energy Hubs

- Facility open to the public that provides shelter during times of emergency

Best Practice: Puerto Rico Mercy Corps Resilience Hub

- Community Gardens
- Internet Connectivity
- Disaster Risk Reduction (workshops and equipment)
- Off-Grid Solar Energy
- Potable Water

Neighborhoods Agenda - Highlight Actions

2. Transportation: Mobility Hubs (swap out graphic for photos)

Neighborhoods Agenda - Highlight Actions

Mobility Hubs - Transportation Options

- Bikes (electric and manual)
- Electric busses and other no/low carbon transportation options
- Bus rapid transit and light rail
- Drone Delivery
- Free public transportation
- Golf Cart shuttles
- Carpool and parking options

Youth Agenda

Who: Tempe Youth and Students

Engagement: Climate Action Plan Youth/Student Forum (June 19, 2021), Focus Groups (August 6, 2021)

Purpose: To provide a space for Tempe youth and students to feel empowered to share their thoughts and advice with the City of Tempe regarding the youth agenda.

Youth Agenda - Actions

Food

Current Tempe Programs:
Food Banks
The Farm Express Bus
Existing School Garden Initiatives
Urban Agriculture and Community Gardens
Farmers Markets
Food Entrepreneurship Pilot Projects

Suggested Programs:
Installing composting sites at schools
Educational cooking programs that use wasted food
School gardens
Reducing/Eliminating cost of school meals

Youth Agenda - Actions

Equity

Food

- Ensure easier access to healthy food for residents of all income levels
- Remove/decrease the taxes on produce and other “healthy” foods
- Provide free or affordable food and water options at transit centers and bus stops

- Increase overall accessibility for people with physical and mental disabilities
- Implement free or affordable transportation options
- Increase tree canopy and overall shade availability in Tempe, especially at transportation centers

Youth Agenda - Partnerships

Who: School Boards and Leaders

- Why: Climate Action Resolutions
  - Creates a stronger sense of community
  - Encourages hands-on learning
  - Generates savings through energy efficiency
  - Fosters more beautiful campuses
  - Raises awareness of climate change and the desire to work towards solutions

Youth Agenda - Partnerships

Involvement and Engagement

- Involved during and after the resolutions are passed
- Continue to attend meetings
- Listen to and enact student ideas
- Ensure the resolutions contain immediate actions

Programs

- Recycling program with incentives
- Educational sessions that empower students to get involved
- Legislation and guidelines around Climate Change education in the classroom
- Immediate and long-term changes

Youth Agenda - Highlight Actions

Green Infrastructure

- Supports urban cooling
- Creates shade
- Saves water
- Captures stormwater
- Keeps streets clear during storms

Youth Agenda - Highlight Actions

Transportation: Mobility Hubs

Youth Agenda - Highlight Actions

Mobility Hubs can:

Increase

- number of transportation options, including electric busses
- affordability of transportation options through discounted or free transportation services
- safe and reliable transportation options
- sense of community
- carpooling and rideshare

Decrease

- single-occupancy vehicle ridership
- carbon emissions throughout the city

CLIMATE JUSTICE

AGENDA

Who: City of Tempe Office of Sustainability, Unlimited Potential

Engagement: Climate Justice Forums (June 19, 2021)

Purpose: To provide a safe and open space for community members to share their thoughts, advice, and ideas with the City of Tempe regarding the Climate Justice agenda.

ACTIONS

Heat Awareness and Energy

- Weatherize and update existing living spaces
- Incentivize the use of natural and clean energy resources
- Fund and mobilize neighborhoods as a collective energy action
- Promote water conservation and increase native vegetation in neighborhoods
- Change electricity billing structure so all users are allotted an amount of energy at no cost
    - Fixed costs affect lower-income residents more than others

ACTIONS

Land Stewardship

- Promote regenerative agriculture, farms, and backyard gardens
- Plant tree canopies along bike lanes and sidewalks
- Plant native vegetation to increase urban cooling and water conservation
- Give back historically unceded land to indigenous communities

PARTNERSHIPS

Community-based organizations - Unlimited Potential

City has the opportunity to work with the communities on:

- Putting a cap on rent to ensure affordable housing
- Safe roads to promote alternative transportation
- Focus on regenerative and healthy forms of agriculture
- Support for the unsheltered
- Moving from consumer culture to a circular economy

HIGHLIGHT ACTION

ENVISION TEMPE

Benefits:

- Promotes community self-reliance and economic sustainability
- Centralizes community-centered institutions and programs
- Improves access to health improvement initiatives
- Revitalizes communities through local efforts
- Fosters greater community connections

Conclusion

Next Steps:

- Look over feedback for new insights and perspectives
- Late fall 2021: Tempe City Council CAP adoption
- If interested, please continue to engage with us in our online forum available from _____- or for more information visit tempe.gov/ClimateAction

MEMORANDUM

TO: Transportation Commission

FROM: Tony Belleau, Tempe Streetcar Project Manager (480-858-2071)

DATE: September 14, 2021

SUBJECT: Tempe Streetcar

PURPOSE

The purpose of this memo is to provide an update on the upcoming Tempe Streetcar (TSC) operations.

CITY COUNCIL STRATEGIC PRIORITY

- Quality of Life 3.26: Achieve a multimodal transportation system (20-minute city) where residents can walk, bicycle, or use public transit to meet all basic daily, non-work needs.
- Quality of Life 3.29: Achieve ratings of "Very Satisfied" or "Satisfied" with the "Overall Satisfaction with Transit System in Tempe" greater than or equal to 80% as measured by the City of Tempe Transit Survey.

BACKGROUND

Working to take advantage of reduced vehicular traffic, the Tempe Streetcar project made significant advances on the construction of the overall system. As construction is now complete, the project team focuses on testing and close-out procedures related to the installation of infrastructure (landscape, civil, trackwork, shelter, traffic, communications, etc.), while working with the vehicle manufacturer, Brookville Equipment Corp (BEC) to verify and test the vehicles on the streetcar alignment in Tempe.

Meanwhile, the Public Art component of the project has progressed, with three of the four zones on the alignment having completed their installations. Valley Metro continues to advance the art for the Rio Salado Zone, which be provided by Tucson artist Barbara Grygutis.

All 14 History Panels for the project have been designed and are presently being prepared for fabrication. These large panels (30x52") highlight the history specific to Streetcar stop locations and was a collaboration with the Tempe History Museum, who curated the panels for 13 of the locations on the alignment. The system will also include a custom design in the O'Odham Homeland Exhibit series specifically for *Oidbaḍ Do'ag* (Tempe Butte) for use as streetcar signage at the Rio Salado and Hayden Ferry Lakeside stop. The Gila River Indian Community Cultural Resource Management Program, in concert with SRPMIC Language Preservation Program and the Tempe Historical Commission, have provided comments and review incorporated in the final design. The design also has been presented at the Four Southern Tribes Cultural Resources Working Group monthly meeting.

STREETCAR VEHICLES & INTEGRATED TESTING

While the project team was able to advance construction labor during the impacts of COVID-19, many facets of the industry were negatively impacted. Material sourcing and supply chains continue to be strained, placing an additional burden on the streetcar vehicle manufacturer.

The Tempe Streetcar Vehicle proceeds west on Rio Salado Parkway during a test procedure

This has impacted the manufacturer's ability to not only produce and ship the streetcar vehicles but slowed their ability to perform 3rd party testing, as well. There are presently three streetcars in Valley Metro's Operations and Maintenance center, with three additional vehicles awaiting shipment to conclude the fleet. Staff continues to work with Valley Metro to onboard the vehicles through testing, commissioning and acceptance in advance of the system opening.

NEXT STEPS

- Continue working with city departments to close out inspections and reviews
- Integration testing of the vehicle and system
- Pre-operations planning

RECOMMENDATION OR DIRECTION REQUESTED

Information only

FISCAL IMPACT or IMPACT TO CURRENT RESOURCES

N/a

ATTACHMENTS

- Presentation

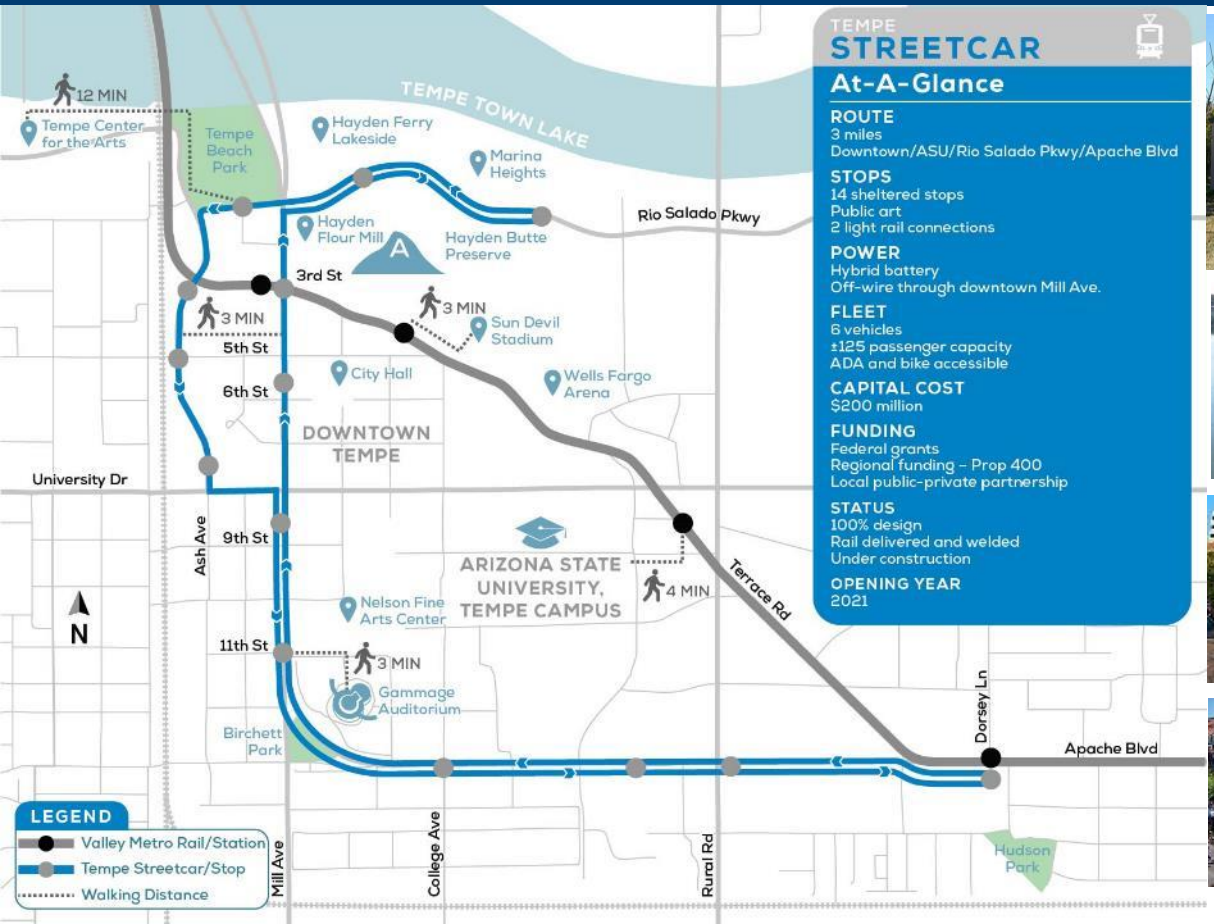
TEMPE STREETCAR

Project Update

Transportation Commission
September 14, 2021

Tempe

Project Overview



TEMPE
STREETCAR
At-A-Glance

ROUTE
3 miles
Downtown/ASU/Rio Salado Pkwy/Apache Blvd

STOPS
14 sheltered stops
Public art
2 light rail connections

POWER
Hybrid battery
Off-wire through downtown Mill Ave.

FLEET
6 vehicles
±125 passenger capacity
ADA and bike accessible

CAPITAL COST
$200 million

FUNDING
Federal grants
Regional funding – Prop 400
Local public-private partnership

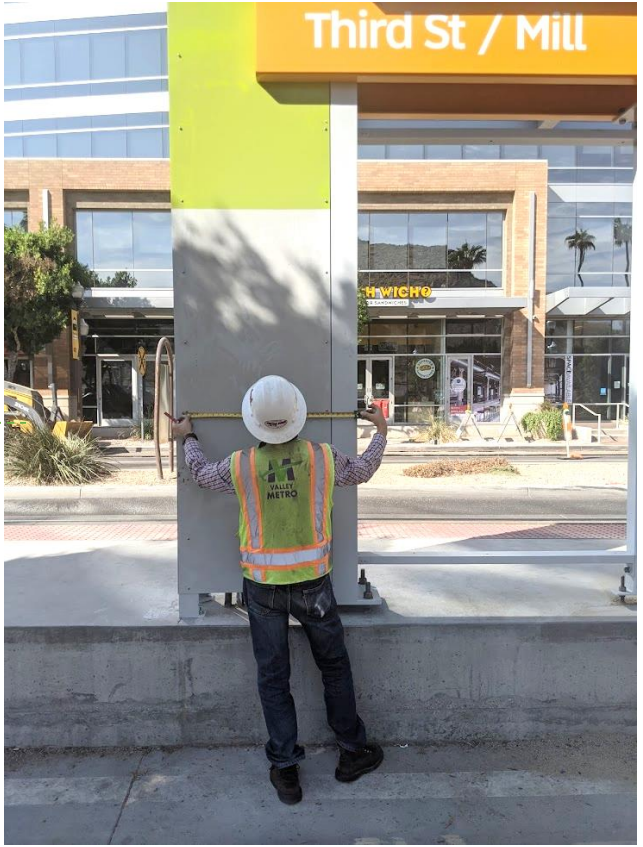
STATUS
100% design
Rail delivered and welded
Under construction

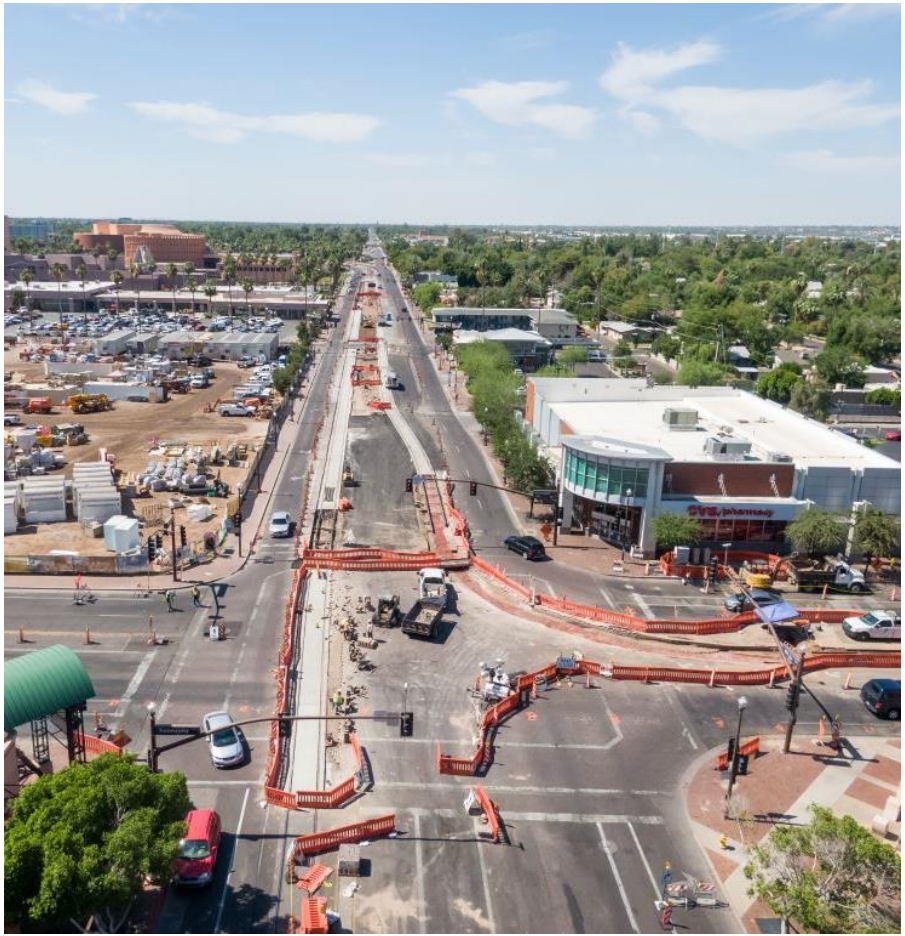
OPENING YEAR
2021

Construction

Substantially Complete Contractor Downsizing Certification

Civil Construction is Substantially Complete
Working to define extended overhead cost
Punch list certifications
Intermittent lane restrictions continue throughout the project
Patching and repairs to miscellaneous concrete
Crews continue to finalize landscaping throughout the project
Striping and signage revisions
Traction Power Substations (TPSS)






WHOLE
FOODS
MARKET


ENGINEERS

Track Feet 27,808 TF or 5.3 Miles

14,000 CY of Excavation

Concrete placed for Track 8,605 CY

Rebar Placed: 1,086,826 lbs

27,065 LF of curbing (~5 miles)

201 OCS Poles

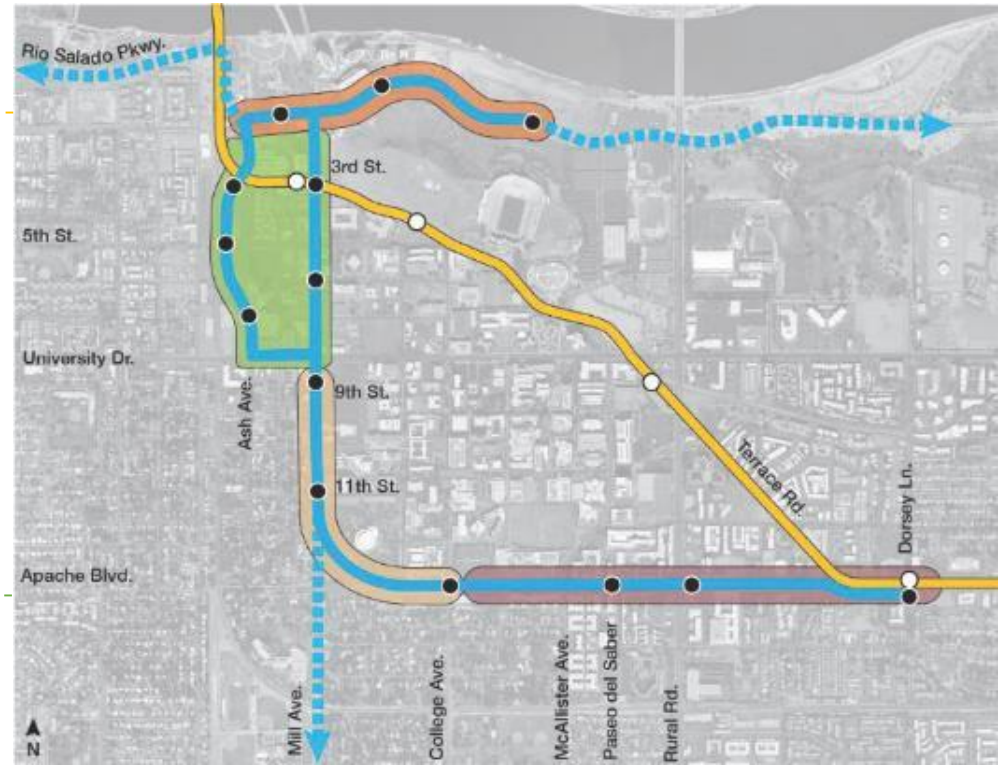
Safety Hours 517,853

Zero Lost Time & 2 RI.

(National Avg = 2.5 RI per 100 workers for 200k hours)

Public Art

Art Installed in 3 of 4 Zones
Rio Salado Update



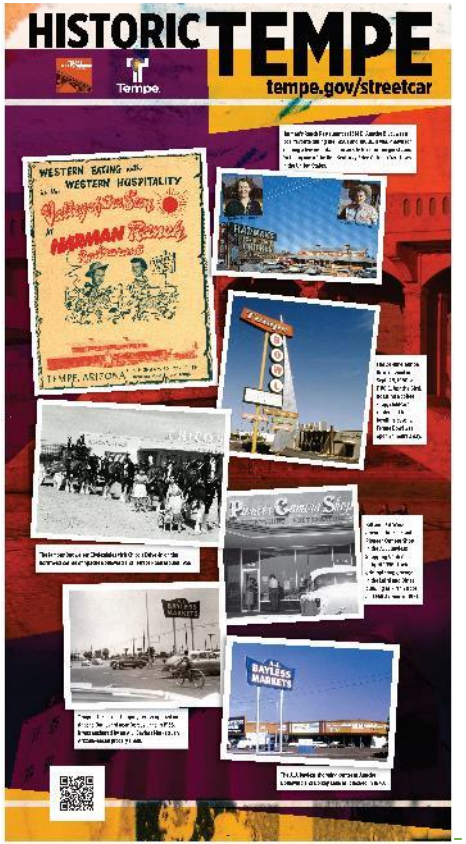
Four Public Art Zones on the Tempe Streetcar Alignment

Gammage | Mary Lucking (Phoenix)

Apache | Bobby Zokaites (Tempe)

Downtown | Simon Donovan & Ben Olmsted (Tucson)

History Panels



TEMPE HISTORY MUSEUM

Curated by Tempe History Museum (13 stops)

Includes O'Odham Homeland Exhibit panel for Oidbad Do-ag (Tempe Butte))

Vehicles

6 Hybrid Vehicles
(Overhead & Battery)

Manufactured in Brookville, PA

3 of 6 Vehicles Delivered

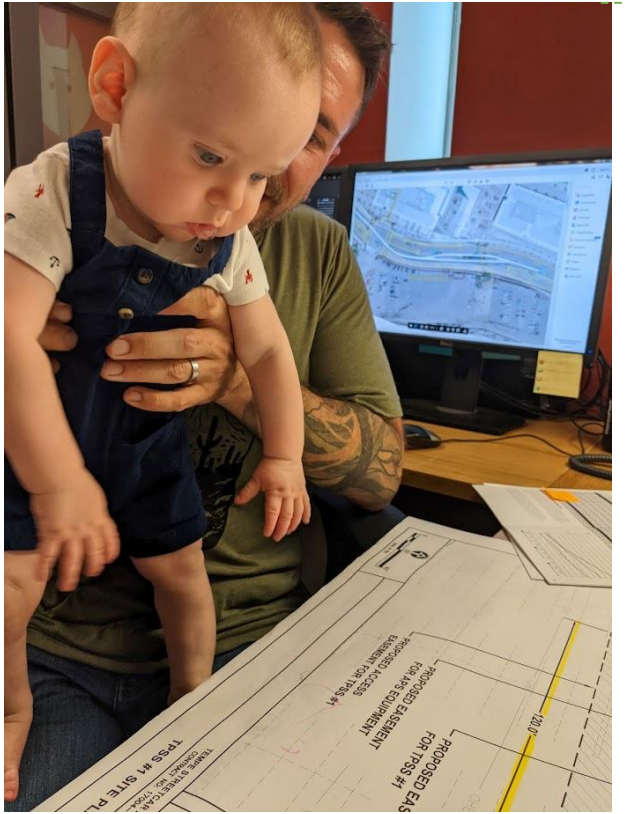
Integrated Testing


180
VALLEY METRO


180
180
VALLEY METRO
VALLEY METRO
Marina Heights/


180
MARTA
180

Schedule & Next Steps



Integrated Testing

Vehicle Delivery Testing / Acceptance

Operation Planning

Regional Fare

Onward

ValleyMetro.org/TempeStreetcar

VALLEY METRO


TEMPE TOWN LAKE
LEGEND
Light Rail
Tempe Streetcar Route
Streetcar Stop
Off-Wire Segment
TPSS Location
Rio Salado
3rd St
5th St
University Dr
9th St
10th St
11th St
Ash Ave
Terrace Rd.
Dorsey Ln.
ASU Gammage
Apache Blvd.
Oak
Mill Ave.
College Ave.
Paseo del Saber
Rural Rd.
N

MEMORANDUM

TO: Tempe Transportation Commission

FROM: Eric Iwersen, Interim Deputy Engineering & Transportation Director

DATE: September 14, 2021

SUBJECT: Future Agenda Items

ITEM #: 9

PURPOSE:
The Chair will request future agenda items from the Commission members.

RECOMMENDATION OR DIRECTION REQUESTED:
This item is for information only.

- October 12
    1. Annual Report
    2. Transit Fund & Program Update/ Transit Shelter Design
    3. Streetscape Transportation Enhancement Program
    4. Scottsdale Road Bike Lanes
    5. Open Mobility Data Standards - Andrew Salzberg (per commission request)
- November 30
    1. Annual Report
    2. Tempe Adaptive Streets Implementation Design Guide
    3. Transit Program Update & Bus Service Governance Study /Transit Security Update
    4. Mobility Hubs
    5. Transportation Demand Management Plan/Transportation Management Association
- December 14 - Canceled
- January 11
    1. Commission business
    2. North/South Rail Spur MUP
    3. MAG Values Mapping
    4. Crosswalk Signal Countdown & Signal Detection for Bicycles
    5. Ash/University Intersection & 1st/Ash/Rio Roundabout Traffic Data Counts Update
- February 8
    1. Personal Delivery Devices
- March 8
    1. Mobility Hubs
    2. Transportation Demand Management Plan/Transportation Management Association
- April 12
- May 10
    1. Bike Hero
- June 14
- TBD: BRT Study
- TBD: Bike Bait (once program resumes)
- TBD: Commuter Rail Study/MAG Commuter Rail Plan
- TBD: AZ State Rail Plan/AZDOT Phoenix-Tucson Corridor Plan