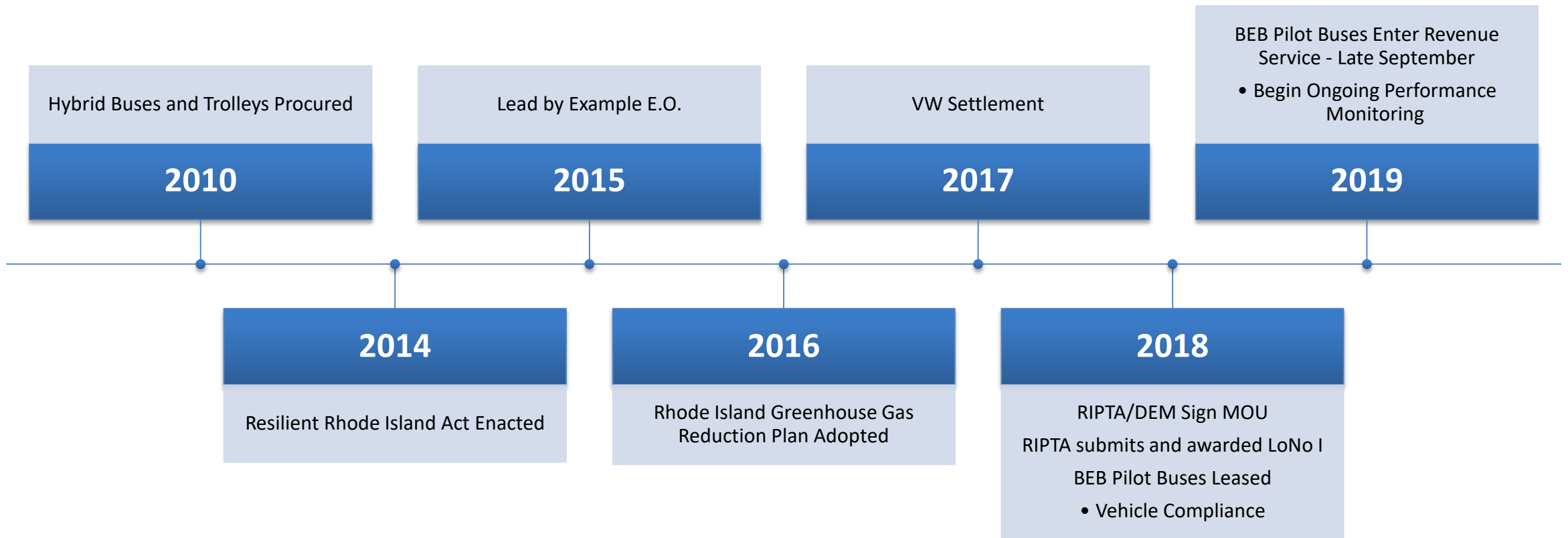




Today's Presentation

- I. ZEV Pilot Program Basics
- II. What We're Learning
- III. Impacts
- IV. Next Steps

Roots of the ZEV Pilot Program



Phase I. Demonstration

- *Testing Vehicle Performance, Energy Usage, and Infrastructure Requirements*

Phase II. Broader Adoption

- *Introduce Fully Battery-Electric Service on the R-Line*

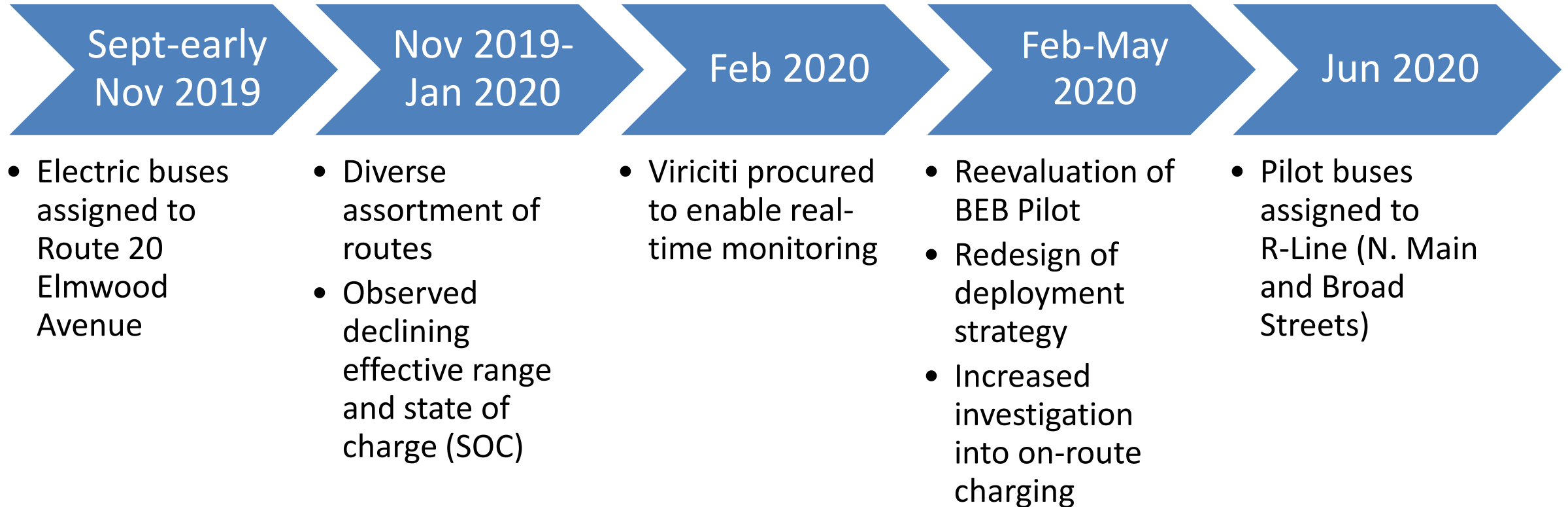
Phase III. Sustainable and Resilient Deployment

- *Begin Electrification of Newport-based Services*
- *Completion of Fleet and Facilities Action Plan to guide Full Deployment System-wide*

- RIPTA leased three 40' Proterra Catalyst E2 buses in Fall 2018.
- Entered service in September 2019 following extensive vehicle compliance and operational review.
- All 3 are charged overnight by depot chargers installed at 265 Melrose Street.
- Equipped with 440 kWh batteries.
- Vehicle performance testing has evolved over time.



ZEV Phase I: Testing



ZEV Phase I: Testing

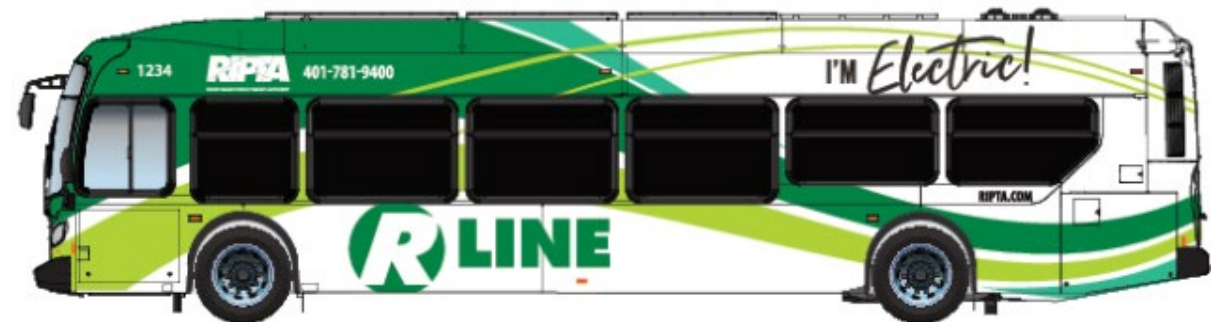
- To ensure increased deployment success, R-Line blocks were restructured to match average electric bus range of +/- 70 miles.
- Despite redirection in pilot, electric bus performance trends match peer experience through remainder of 2020 and into 2021.
- During summer and fall, staff undertake energy and vehicle modeling on the R-Line blocks operated by the electric buses and validate the criticality of on-route charging for successful deployment.
- Pilot buses showed month-over-month improvement in performance during spring/summer, but some issues persist.

R-Line Blocks prior to Pilot Ph. 1			
<u>Block</u>	<u>Vehicles Req.</u>	<u>Vehicle Type</u>	<u>Distance</u>
11-1	1	Diesel	136.53
11-11	1	Diesel	118.69
11-12	1	Diesel	103.29
Totals	3		358.51

R-Line Blocks during Pilot, Ph. 1			
<u>Block</u>	<u>Vehicles Req.</u>	<u>Vehicle Type</u>	<u>Distance</u>
11-1	1	Diesel	69.86
11-13	1	Electric	69.96
11-11	1	Electric	69.96
11-15	1	Diesel	52.02
11-12	1	Electric	69.96
11-16	1	Diesel	36.63
Totals	6		368.39

ZEV Phase II: Expansion

- 14 40-foot New Flyer Xcelesor XE40 buses.
- Scheduled for delivery in Fall 2022. Alignment with infrastructure is paramount.
- Will operate exclusively on the R-Line. Every 1 in 5 RIPTA passenger trips zero-emissions.
- On-route charging will occur at Broad/Montgomery.
 - Construction bid has been awarded, anticipated to begin this Spring.



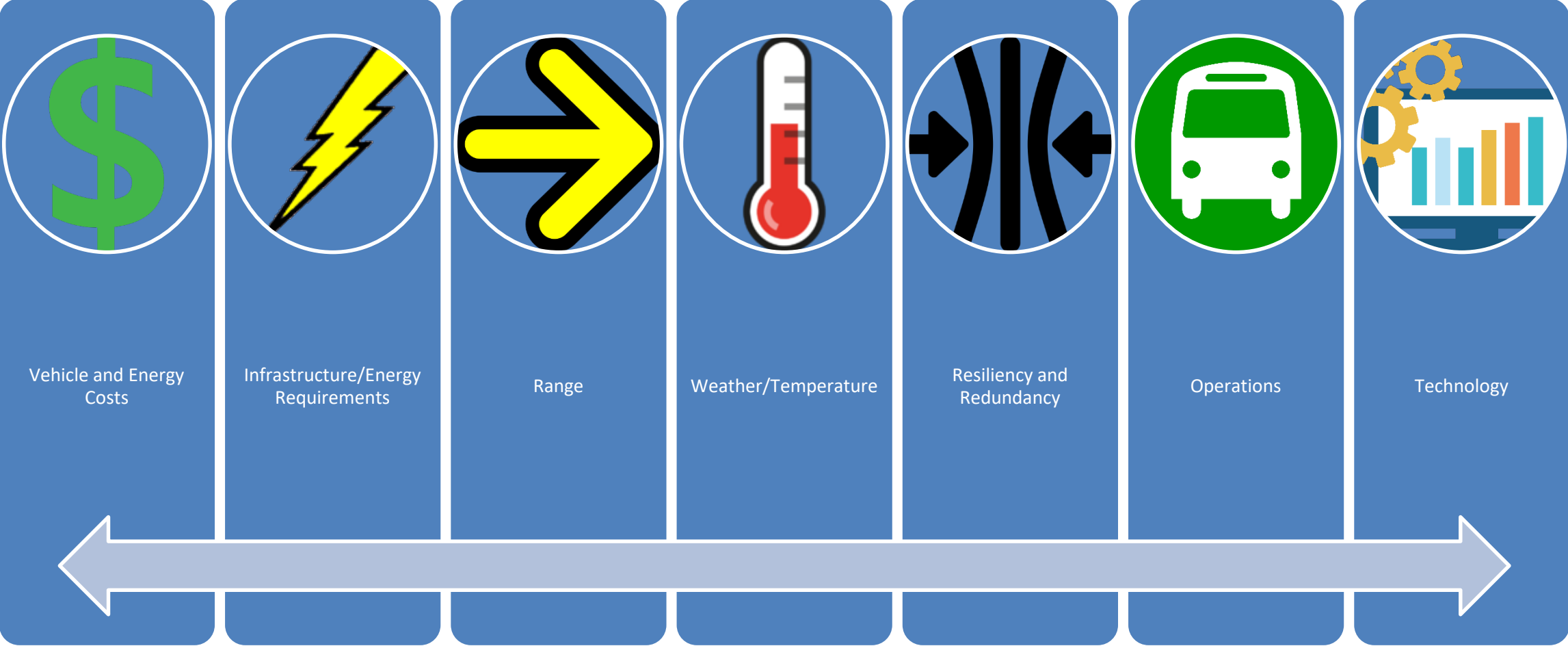
ZEV Phase III: Aquidneck

- Funded by FTA, RIPTA, and the State of Rhode Island.
- Procurement of up to 40 battery-electric buses.
- Facility improvements and charging equipment at Newport Gateway Center, RIPTA Middletown Garage, and planned URI Regional Mobility Hub.
- Funding for technical assistance associated with long term operational resiliency.
- \$1.5M Battery Storage Demonstration funded by OER.
- Sen. Reed has secured \$4M for the project through a THUD earmark.



What We're Learning

What We're Learning

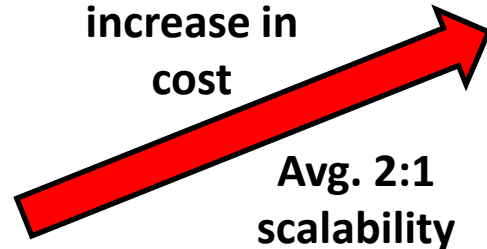


Vehicle Price and Scalability



Standard diesel bus

40%
increase in
cost

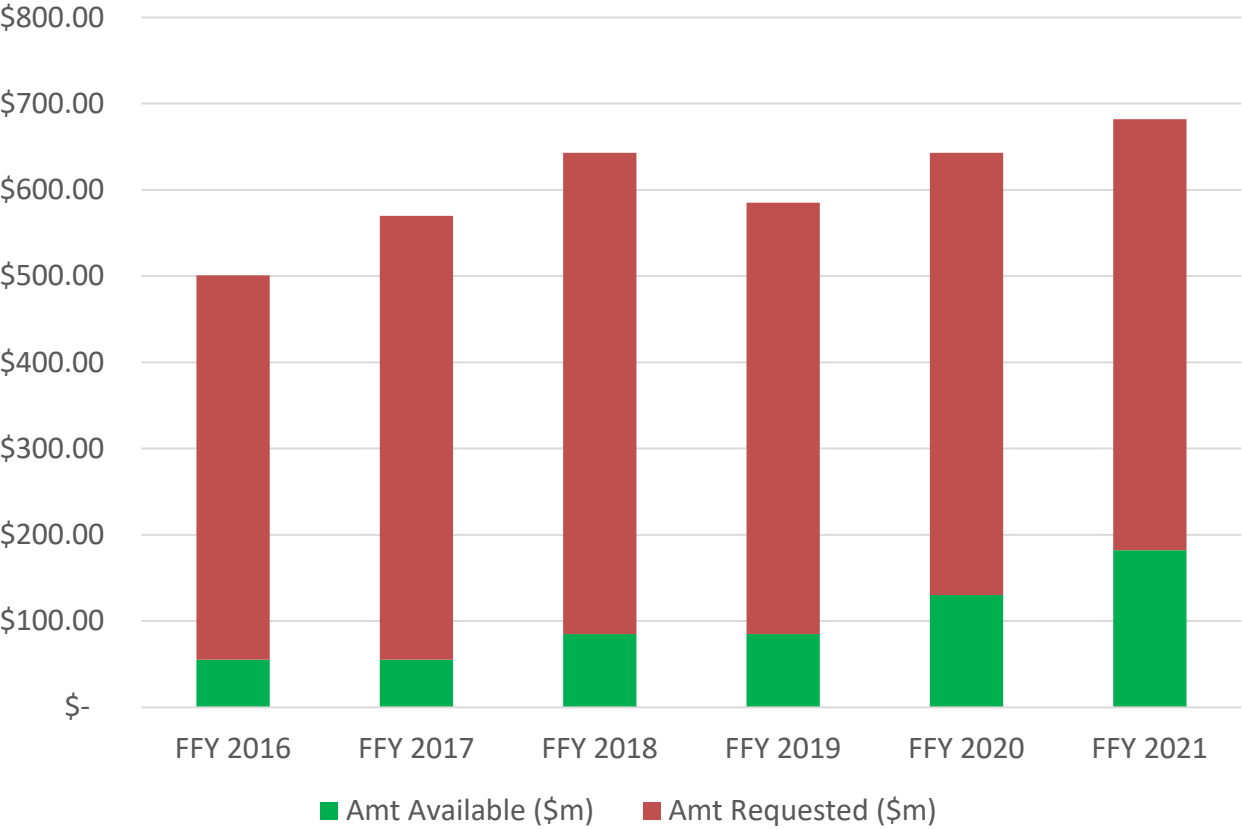


Avg. 2:1
scalability



Battery electric bus

Low/No Emissions Vehicle Program (FFY 16-21)



RIPTA Low/No Emissions Vehicle Grant Awards

- FFY 2018
 - Requested: \$3.5 million
 - Awarded: \$1.5 million
- FFY 2020
 - Requested: 5.07 million
 - Awarded: \$5.07 million
- FFY 2021
 - Requested: \$13.44 million
 - Awarded: \$5.15 million

- RIPTA is a commercial utility ratepayer. We do **not** have a special rate.
- Electricity usage estimated to increase by a third above current levels upon operation of Phase II.
- RIPTA and National Grid are working on securing a short-term discount on demand charges to the extent possible under the existing rate case.
- More electric buses = increase in electricity usage = increased electricity costs = increased OpEx



Energy Requirements



14 battery electric buses



1.2 MW



+/- 1000 houses



Multiple Charging Options / Rapidly Evolving Technology:



Depot (slow) charging

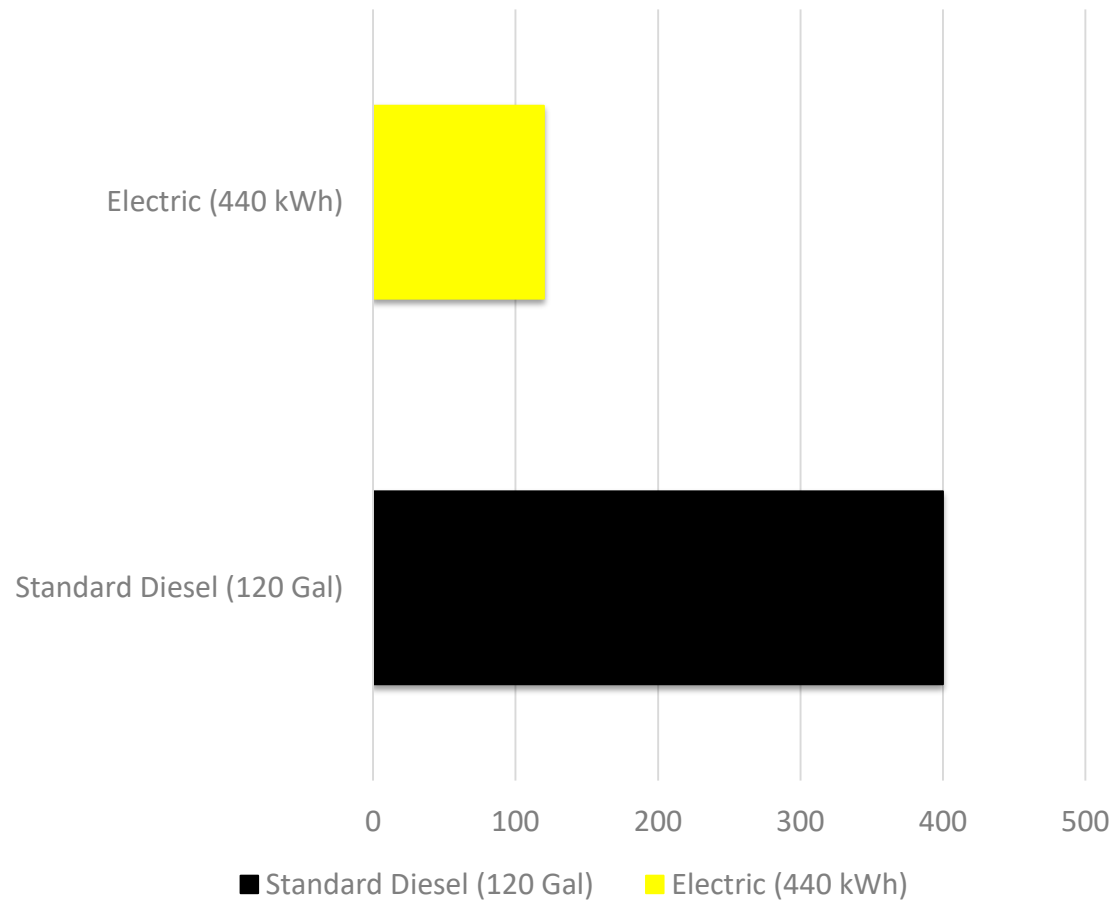


Pantograph (fast) charging



Wireless/induction (fast) charging

Current range experience



- Bus manufacturers claim their vehicles can run between 200-300 miles/day (under ideal conditions).
 - Major divergence between ideal and real-life operation.
- 50% of RIPTA's service is above 140 miles/day.
- Due to unique service profile, we have higher than average service blocks than compared to our peers.
- If we were to transition the fleet using existing service design, there would be an increase in OpEx and CapEx
- Charging strategy is key to offsetting range limitations on some routes.

Weather/Temperature Impacts

- Research by the Zero Emission Bus Resource Alliance (ZEBRA) finds that below 40 or above 90°F, state of charge and effective range decline by 30%. RIPTA's own experience validates this finding.
- Use of heating and cooling during respective seasons increase energy consumption on HVAC and reduce available energy for propulsion.
- On very cold winter mornings, buses of any propulsion type need to be pre-heated to ensure key systems are safe and operable. Immediately running a BEB with a cold battery results in short duration of service.
- RIPTA has seen higher than average kWh/mi energy consumption on very cold and very hot days. This translates to higher electricity costs.



Resiliency and Redundancy

- Fleet transition requires contingency planning for continuity of service.
 - Imperative that infrastructure projects by RIDOT and municipalities align with fleet transition in the future.
- Ever-worsening conditions caused by climate change suggest that research into resilient infrastructure and redundancy measures is advisable.
- Potential areas to explore include:
 - Renewable energy solutions
 - Battery storage technology
 - Micro grid technology
- RIPTA's Newport Electrification Project incorporates a battery storage demonstration in partnership with the Office of Energy Resources.



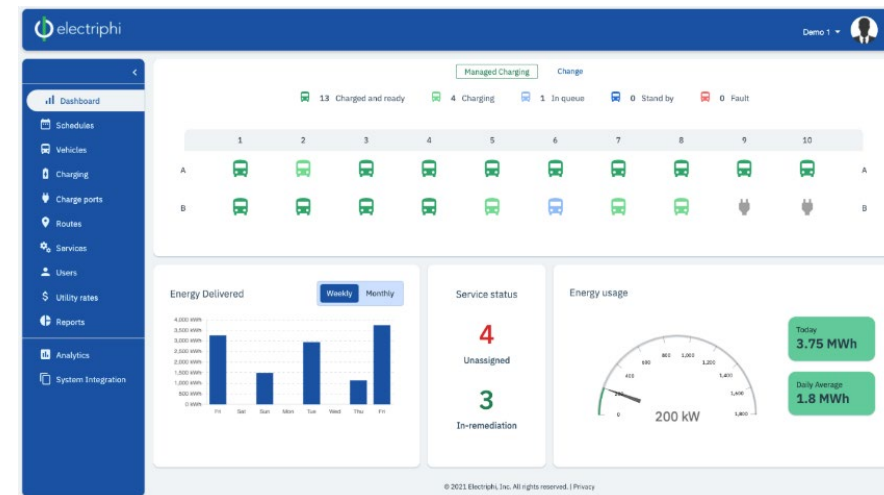
Impacts on Transportation Operations

- Driver Training:
 - Use of on-route charging equipment
 - Regenerative braking and acceleration
 - Cognizance of battery state-of-charge
- Maintenance Training and Processes
- Vehicle Storage and Staging
- Impacts of Range on Scheduling and Vehicle Requirements
- Different Approach to Procurement



Supportive Technology

- Real-Time Vehicle Performance Monitoring
- Real-Time Charging Infrastructure Monitoring
- Smart Charge and Power Management Systems
- Ongoing Data Collection and KPI Analysis
- Integration with Scheduling Software
- Service Modeling and Optimization of Service Functionality

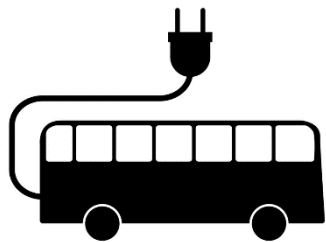


Next Steps

- Integrate fleet electrification & Transit Master Plan implementation
- Continue to strengthen partnerships with DEM, OER, National Grid, City of Providence, and others
- Leverage federal infrastructure investment

Next Steps: TMP/ZEV Fleet Action Plan

ZEV Implementation



TMP Implementation



BETTER TRANSIT  BETTER RHODE ISLAND

Fleet &
Facilities
Action
Plan

Next Steps: TMP/ZEV Fleet Action Plan

- ▶ Improve existing services
- 📖 Expand service to new areas
- 🚊 Develop High Capacity Transit
- 📍 Improve access to transit
- 👉 Make service easier to use



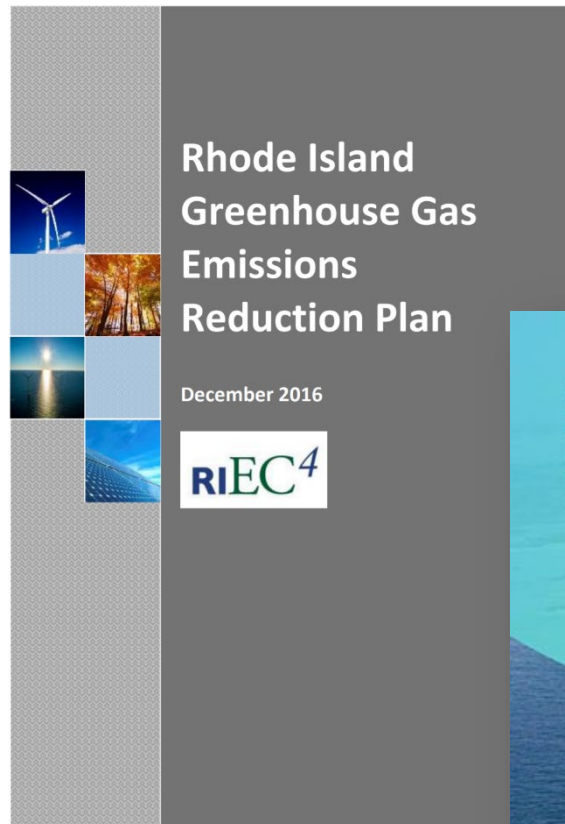
Adopted December 2020

Next Steps: Partnerships

“Focus on the implementation of Transit Forward RI, the 20-year plan, with priority consideration given to the improvement of accessibility, service frequency and span in urban areas to improve mobility for underserved populations. In addition, expand lifeline service and flexible microtransit in rural parts of the state.”

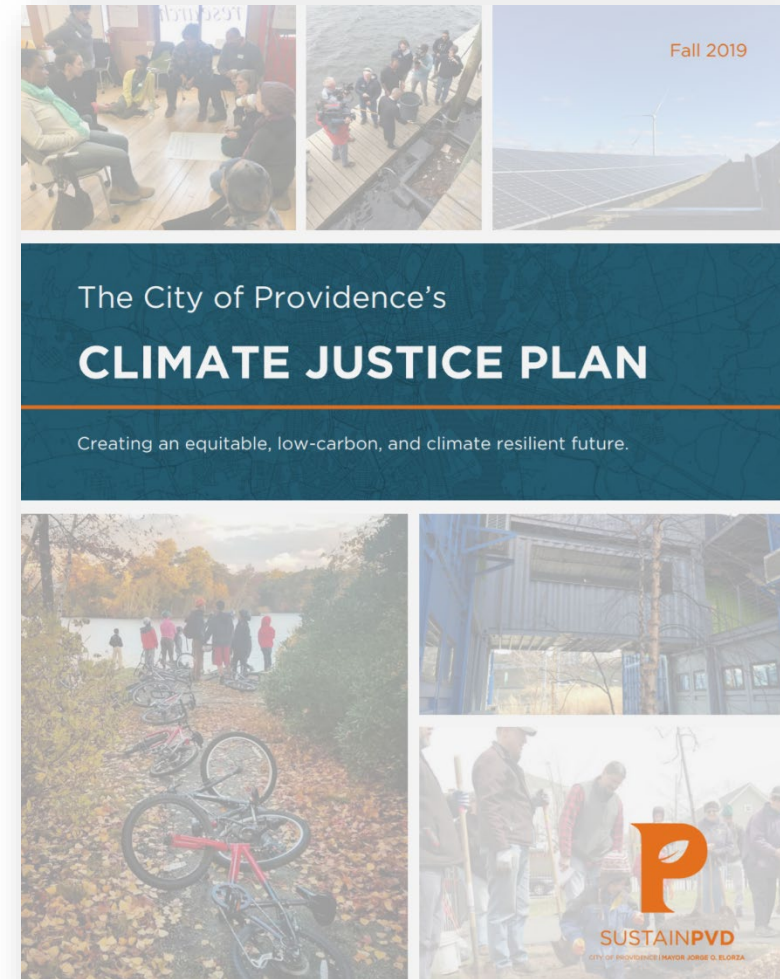


Next Steps: Partnerships



Next Steps: Partnerships

“Ensure that all [Providence] residents have access to clean and efficient public transportation...increase low-carbon transit options in frontline communities...”



Next Steps: Leverage Federal Funding



- This is a Brave New World.
- ZEV technology is evolving... we need to move forward strategically.
- A 100% zero-emissions RIPTA fleet requires a long term sustained investment.
- Improving transit service will produce faster and greater reductions in GHGs overall, while also bringing greater health and equity benefits.

Thank You!



ZEV Program Contacts:

Zachary Agush
Capital Planner
zagush@ripta.com

Sarah Ingle
Director of Long Range Planning
ingle@ripta.com

Greg Nordin
Chief of Strategic Advancement
gnordin@ripta.com