



SFMTA



# Battery Electric Bus Pilot Evaluation

SFMTA Board of Directors Meeting  
September 17, 2024

# Citywide Climate Action: Transportation Goals

**Net-zero** greenhouse gas emissions by 2040

**80% of trips are low-carbon trips by 2030**

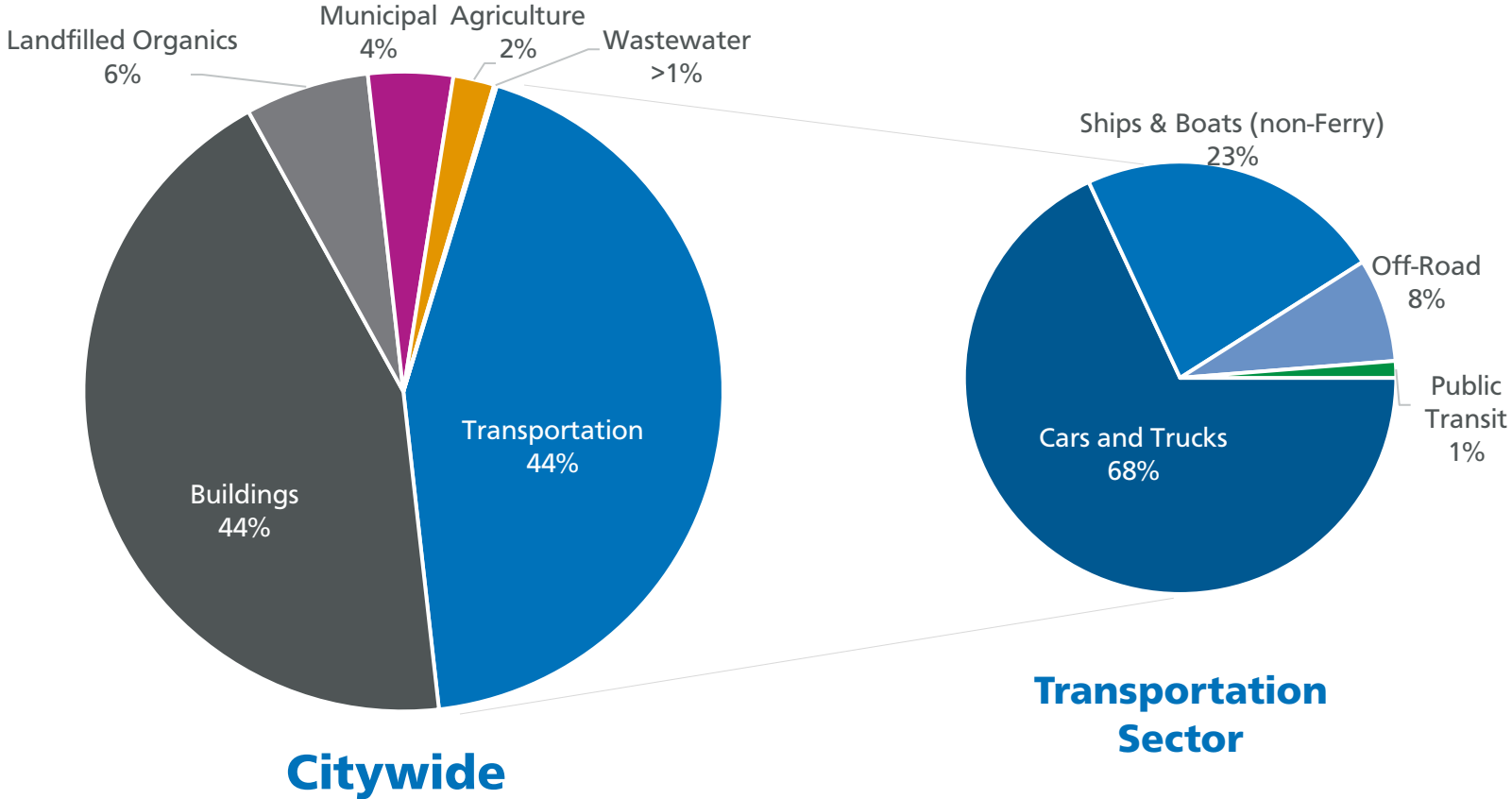
Transit, walking, bicycling, trips in vehicles with 3+ people and electric vehicles

**25% of registrations are electric vehicles (EVs) by 2030 and 100% by 2040**



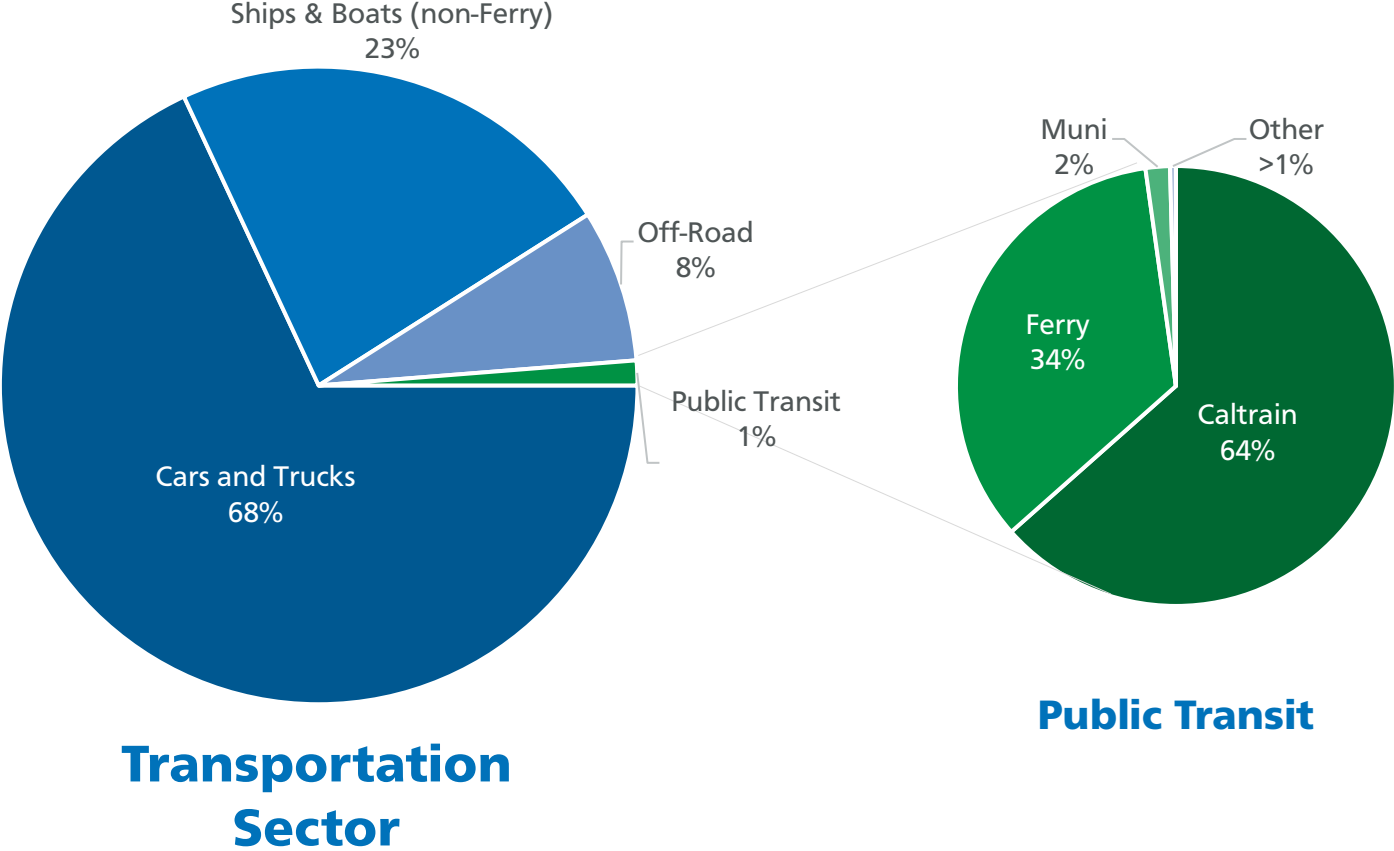
# Transportation is one of the largest generators of greenhouse gas emissions in San Francisco

San Francisco Greenhouse Gas Emissions, 2020

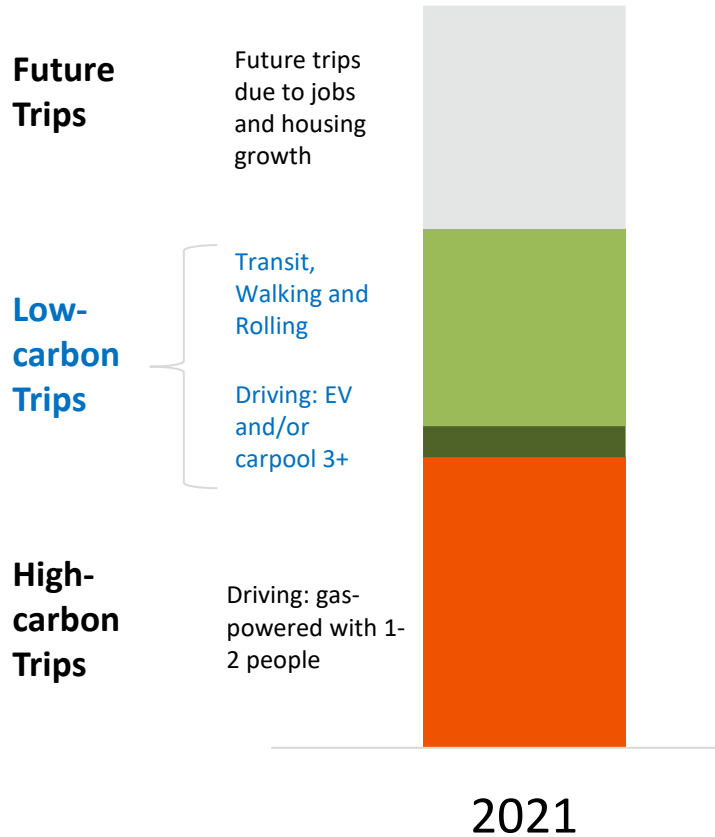


# Most transportation emissions come from cars and trucks; very little from Muni

San Francisco Greenhouse Gas Emissions, 2020



# Most trips are made by driving gas-powered vehicles with only one or two people



Since the pandemic, trips on transit are down



Drive alone trips are up.







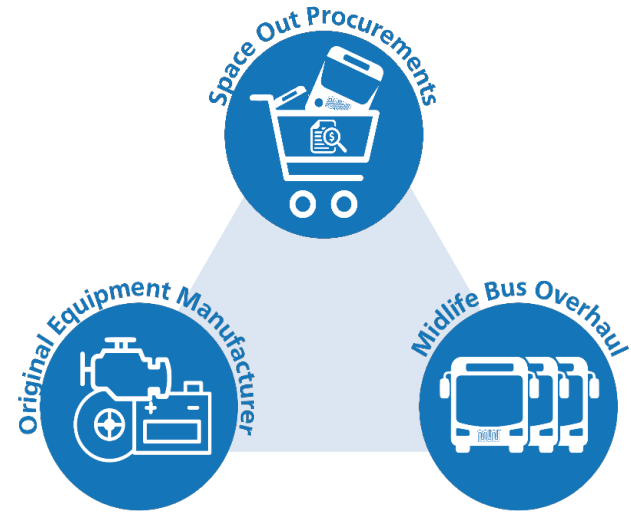
**Reliable transit** is the best way to reduce vehicle emissions.

Low carbon modes need to be the preferred ways to get around.



# Fleet Management Transformation

- Maintain consistent fleet average age and state of good repair.
- Performance-based procurements.
- Uphold robust maintenance standards and midlife investments.
- Proactive maintenance: using data to fix things before they break.



# Progress Towards Zero Emissions

**2007:** SFMTA is an early adopter of hybrid buses.

**2017/2018:** Green Zones introduced to 68 buses.

**2018:** CARB adopts the Innovative Clean Transit (ICT) regulation calling for full electrification by 2040.

**2022:** First BEB pilot buses enter revenue service.

**2023:** Updated SFMTA's Zero Emission Vehicle Policy to Align with the ICT regulation, allowing for the procurement of all zero-emission technologies.

**Muni runs the greenest fleet of any major city in North America.**



# Battery Electric Bus Pilot Goals

- Evaluate state of battery electric bus technology.
- Encourage OEM participation in SFMTA procurements.
- Evaluate performance, reliability, maintainability, and operability in our unique environment.
- Evaluate production quality and customer service of multiple manufacturers.



**NEW FLYER**



**BYD AUTO**



**PROTERRA**

**NOVA BUS**



# Pilot Evaluation Criteria

A man wearing a light blue short-sleeved shirt, dark blue trousers, a high-visibility yellow safety vest, and safety glasses is kneeling on the floor of a garage. He is looking at the side of a red bus. The bus has a white door that is open. A sign on the bus reads "STAGE MAINTENANCE ACCESS ONLY". The background shows a well-lit garage with various equipment and a red scissor lift.

Procurement & Customer Experience

Acceptance

Performance

Operability

● Maintainability/Reliability

Financial

# Pilot Evaluation Results

- Buses met or exceeded our technical requirements and specifications.
- Large US bus manufacturers performed well due to their manufacturing experience and customer experience.
- Smaller manufacturers need more time to refine their production processes.
- Reliability of BEBs did not perform up to our expectations (primarily due to first generation technology bugs).



ASSESSMENT



ANALYSIS



PERFORMANCE



IMPROVEMENT



RESULT



FEEDBACK



# Pilot Evaluation Results

Evaluation Category	New Flyer	BYD	Proterra	Nova
Procurement and Customer Experience	153	78	74	114
Acceptance	18	6	18	21
Performance	99	71	63	64
Operability	27	15	9	21
Maintainability and Reliability	82	67	65	59
Financial	18	24	15	6
<b>Weighted OEM Score</b>	<b>397</b>	<b>261</b>	<b>244</b>	<b>285</b>
<b>OEM Score (%)</b>	<b>76.79%</b>	<b>50.48%</b>	<b>47.20%</b>	<b>57.34%</b>

# Pilot Evaluation Results

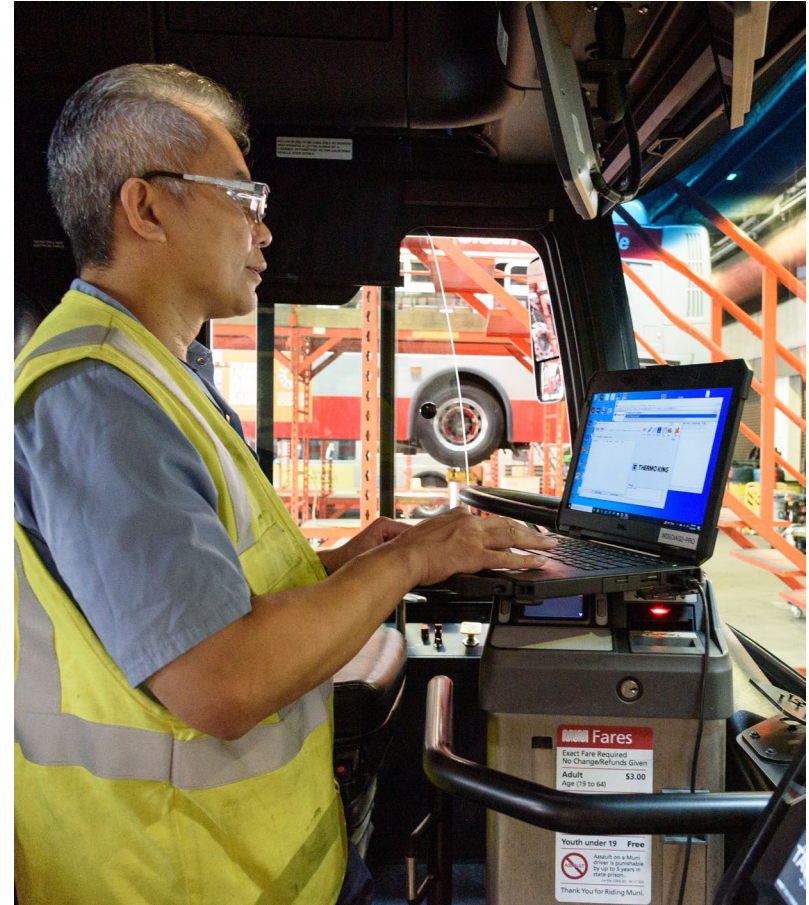
- **New Flyer and Gillig** are currently the only viable US manufacturers for the SFMTA's future BEB procurements.
- **Nova Bus** exited the US market.
- **BYD needs to resolve issues** with bus quality and federal procurement funding.
- **Proterra cannot be recommended** at this time due to bankruptcy and restructuring, poor customer support, and poor parts availability.



# Lessons Learned

## Challenges with New Technology

- BEB technology is rapidly evolving.
- BEBs can navigate San Francisco's operating environment.
- Reliability is not comparable to existing buses but will improve over time.





# Lessons Learned

## On-board Battery Capacity

- Analysis of pilot vehicles shows we can reduce battery capacity in future procurements.

## Integration of New Systems and Sub-Suppliers

- Reliability issues from new systems, such as CAD/AVL, doors, and radios impacted performance of the pilot buses.



# Lessons Learned

## Training & Workforce Readiness

- Minimal training needed to transition staff
- Expanded workforce for infrastructure maintenance

Labor Task	Union
BEB Maintenance	Local 1414
Trolley Maintenance	IBEW Local 6
Overhead & Charging Infrastructure	IBEW Local 6
Electronic Component Repair	IBEW Local 6



# Lessons Learned

## State of the Industry

- Lack of large-scale bus manufacturers is an industry challenge.
- SFMTA adopting APTA Bus Manufacturing Task Force recommendations to help increase competition and stabilize prices.
- SFMTA will continue to pursue multiple large-scale manufacturers to maximize future competition.

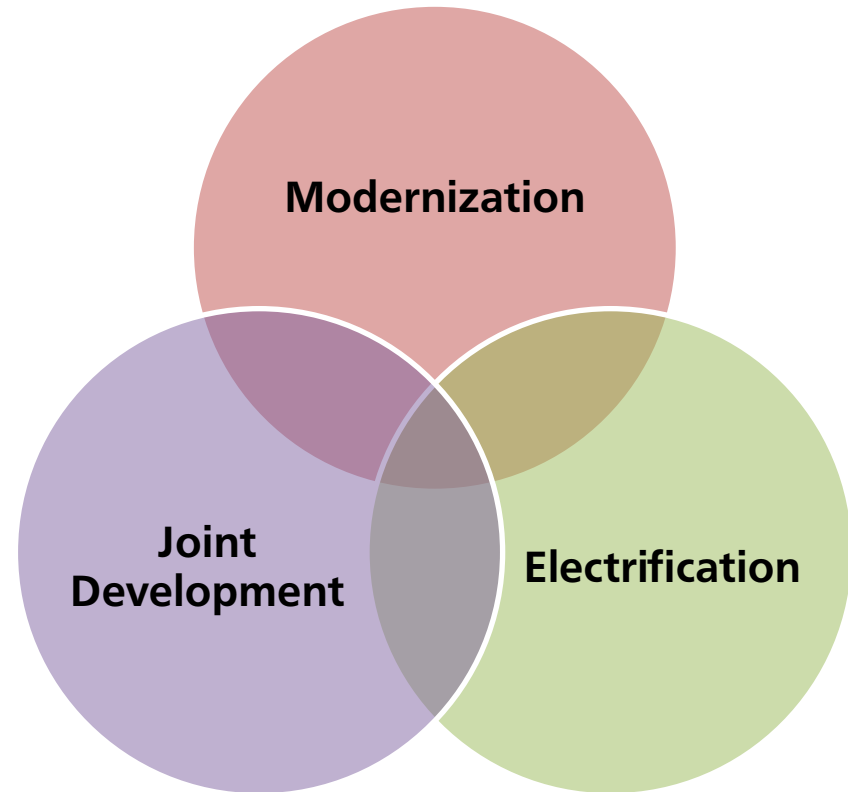




# Lessons Learned

## Facility Upgrades

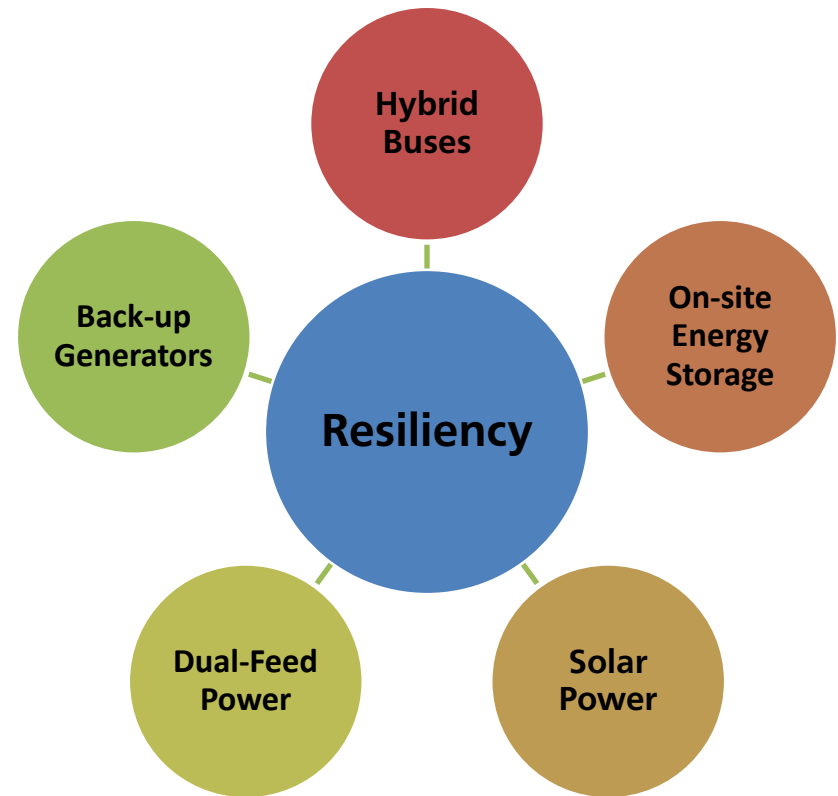
- Facility upgrades more complex than vehicle procurements due to cost, regulatory complexity, and coordination with utilities.
- Alignment between Building Progress and Fleet Plan critical and captured in updated Facility Framework.
- Large costs associated with electrification represent greatest risk to the program.



# Lessons Learned

## BEBs and Resiliency

- Role of BEBs in a natural disaster are unknown.
- Microgrids, dual-feed power, and back-up generators may be key to resiliency in future.
- Hybrid buses will provide resiliency until full electrification.



# Next Steps - BEB



Facility Grant enables purchasing of 18 battery electric buses:

- 4 x 40 ft and 3 x 60ft BEBs from New Flyer
- 5 x 40 ft BEBs from Gillig
- 3 x 40 ft and 3 x 60 ft BEBs from Solaris

Additional battery electric bus expansions will be linked to future facility upgrades.

# Next Steps - Trolleys



Trolleys are an important part of the SFMTA's ZEV Program.

In Motion Charging trolleys are promising – currently conducting a pilot.

The SFMTA will continue to procure trolley buses.

- Formed a consortium of North American trolley bus operators.
- Partnering with Solaris, leading manufacturer of trolleys in Europe.





# Next Steps - Hybrids

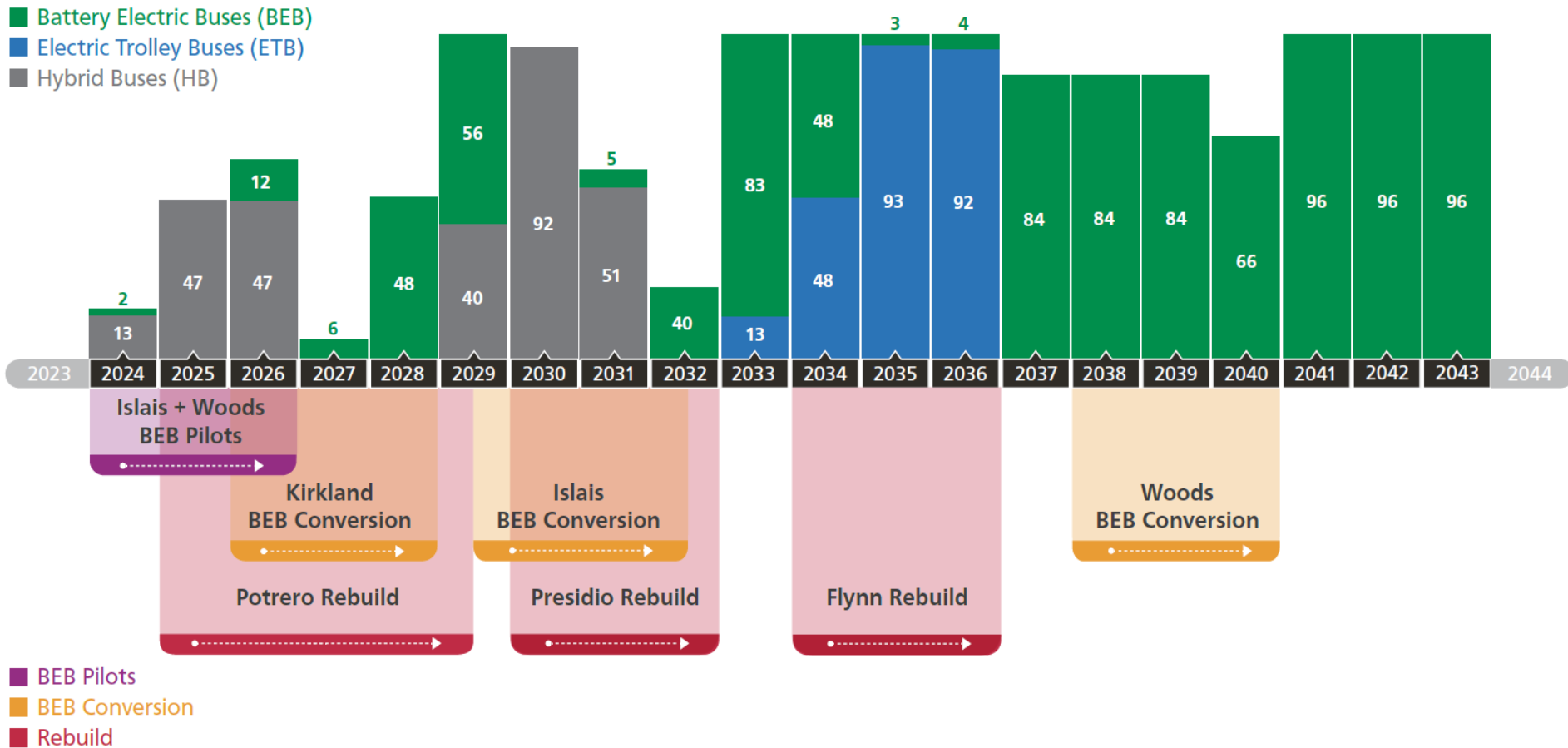


Recommending procuring 94 hybrid electric buses from New Flyer.

Facilities Framework identifies need to purchase mix of low and zero emission buses through 2031.



# Low and Zero Emission Procurements



A photograph of a row of buses, likely at a depot or station, with a blue color overlay. The buses are white with red accents and feature the 'NOVA' logo on the side. The bus numbers 5003 and 5005 are visible on the front of the buses. The text 'Thank you' is overlaid in white, centered on the image.

Thank you