Massachusetts Bay Transportation Authority

Modernizing Our Bus Fleet and Facilities

Fiscal and Management Control Board

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MBTA Bus Transformation Program – Goals and Objectives

Why bus? The MBTA will continue to make integrated investments in bus because of the stable demand for service, especially from our transit critical ridership

What is the Vision for Bus? Better, faster, lower-emissions service, that is more aligned with where riders live, work, and travel, using modern vehicles that provide safe, reliable, and comfortable service.

How will we get there?

- Continue to invest in our fleet in a consistent manner that reduces Green-House-Gas (GHG) emissions, and makes maintenance needs more predictable
- Advance facility investments to improve working conditions, be ready for advancements in bus fleet technology, and be good neighbors
- MBTA's Better Bus Project also includes a range of transit priority, customer amenity, and service improvements

Four Bus Transformation Initiatives to Reach our Goals

Bus Procurements

Continue investing in the bus fleet by replacing old fleets on a consistent schedule in order to maintain a safe and reliable bus service (includes continued assessment of future technologies)

Bus Facilities

Increase investment in aging and outdated facilities to accommodate modern buses and support fleet wide electrification, while improving conditions for our workforce

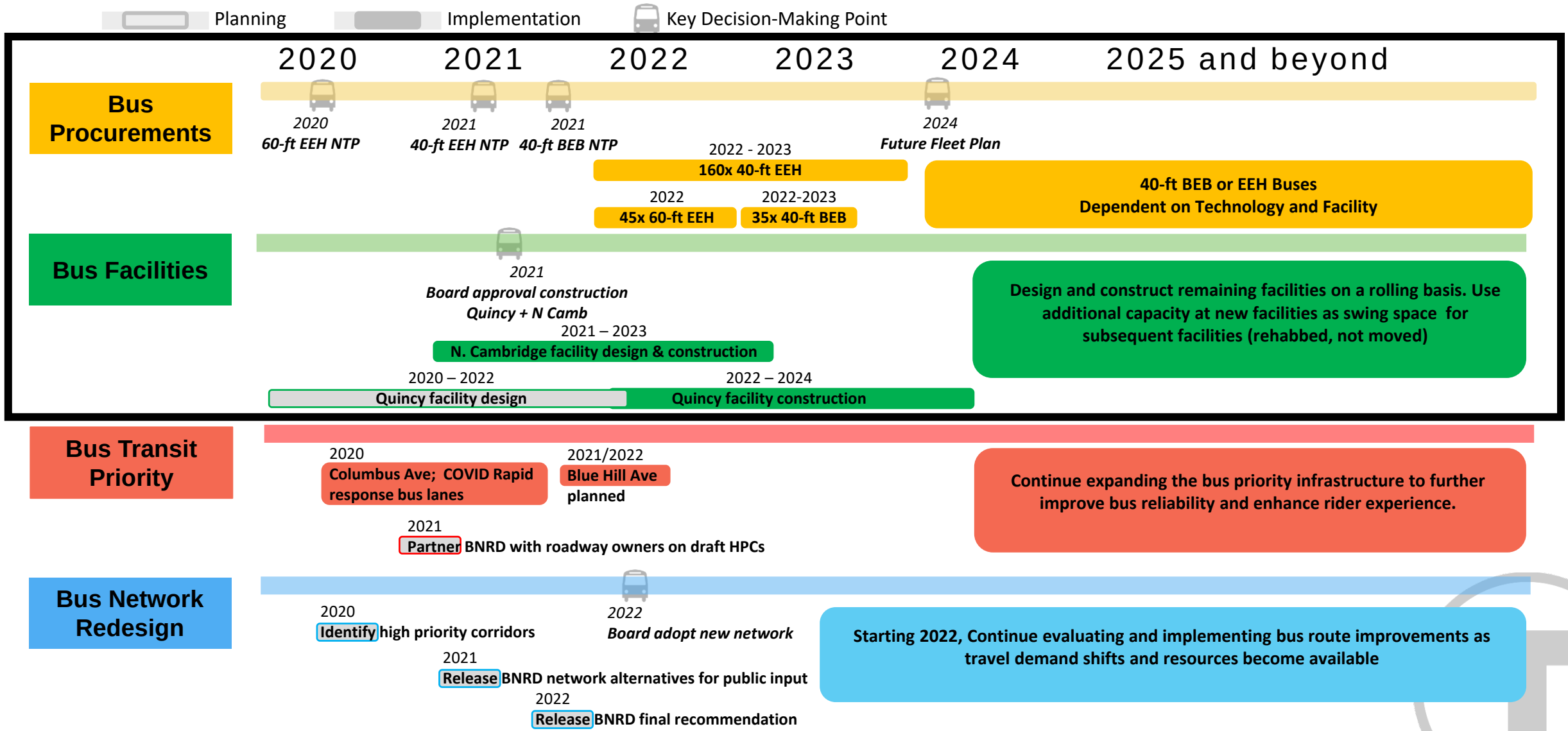
Bus Transit Priority

Partnering with cities and towns to prioritize the movement of people instead of vehicles on congested streets

Bus Network Redesign

Complete re-imagining of the network to reflect regional travel needs and create more competitive service for current and future riders

Bus Transformation Initiatives Timeline

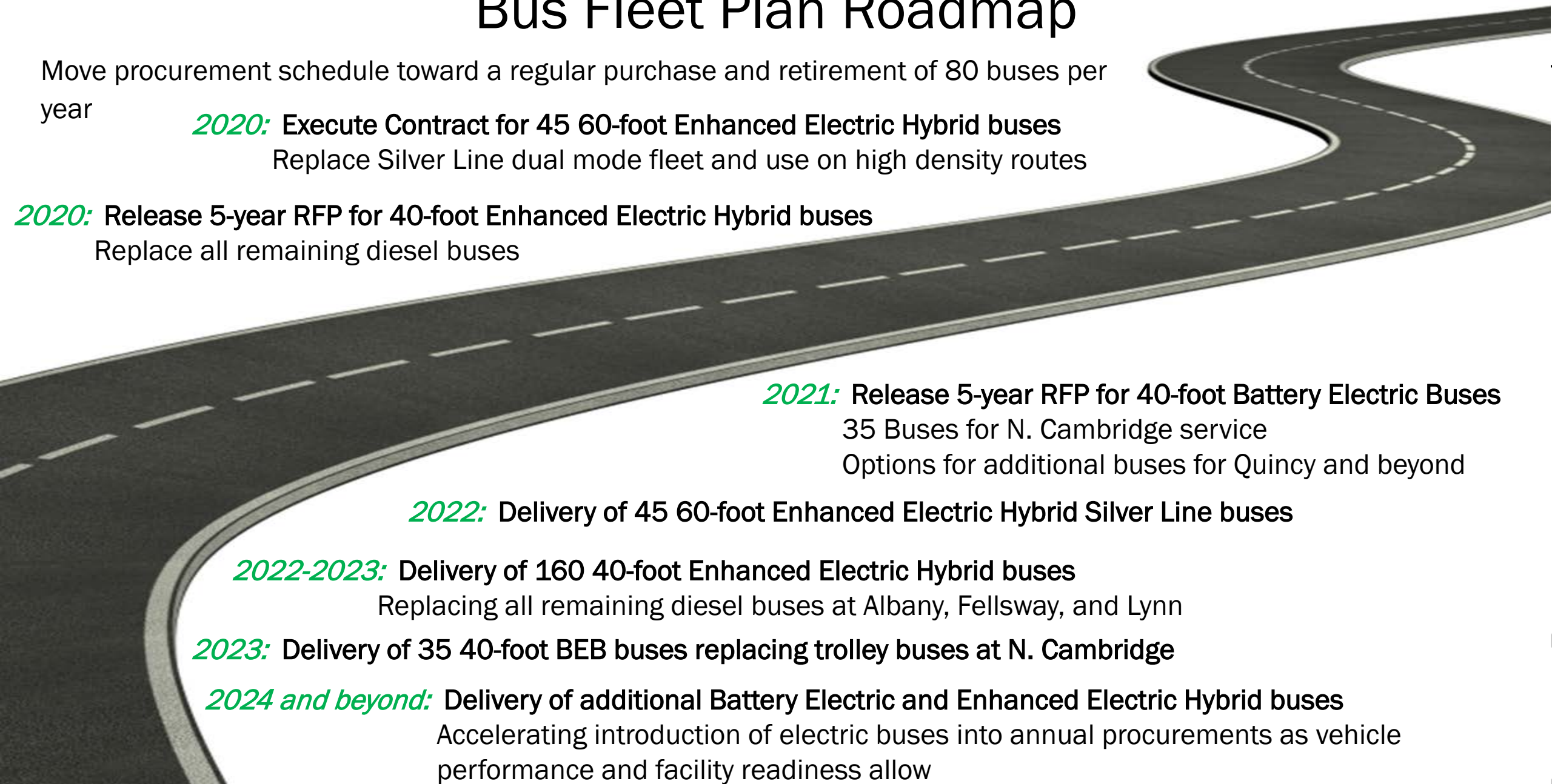


Bus Fleet Plan Roadmap

Move procurement schedule toward a regular purchase and retirement of 80 buses per year

2020: **Execute Contract for 45 60-foot Enhanced Electric Hybrid buses**
Replace Silver Line dual mode fleet and use on high density routes

2020: **Release 5-year RFP for 40-foot Enhanced Electric Hybrid buses**
Replace all remaining diesel buses



2021: **Release 5-year RFP for 40-foot Battery Electric Buses**
35 Buses for N. Cambridge service
Options for additional buses for Quincy and beyond

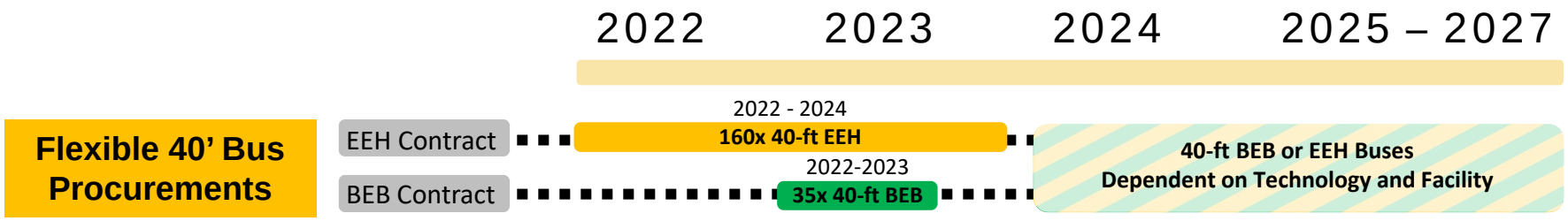
2022: **Delivery of 45 60-foot Enhanced Electric Hybrid Silver Line buses**

2022-2023: **Delivery of 160 40-foot Enhanced Electric Hybrid buses**
Replacing all remaining diesel buses at Albany, Fellsway, and Lynn

2023: **Delivery of 35 40-foot BEB buses replacing trolley buses at N. Cambridge**

2024 and beyond: **Delivery of additional Battery Electric and Enhanced Electric Hybrid buses**
Accelerating introduction of electric buses into annual procurements as vehicle performance and facility readiness allow

Moving Towards Steady Procurements, Maximum Flexibility



Bus Fleets	Fleet Size	Current Age	Target Retirement	Replacement Cost
Neoplan 60-ft Dual Mode	32	14-16	2021 – 2022	$89.4 M
Neoplan 40-ft Elec Trolley	28	16	2023 – 2024	$52.9 M
New Flyer 40-ft Diesel	155	13	2022 – 2024	$162.9 M
New Flyer 40-ft Diesel	155	11	2024 – 2026	$165 M* (est.)
New Flyer 60-ft Hybrid	25	10	2024 – 2025	
New Flyer 40-ft Hybrid	60	6	2026 – 2027	
New Flyer 40-ft CNG	175	4	2028 – 2031	
New Flyer 40-ft Hybrid	156	4	2028 – 2031	*Anticipated $100 - 140M annually*
New Flyer 60-ft Hybrid	45	4	2028 –2031	
New Flyer 60-ft Battery Electric	5	1	2031	
New Flyer 40-ft Hybrid	194	1	2031 – 2032	
New Flyer 40-ft Hybrid	60	0	2032 – 2033	
TOTAL	1,090		*Average Fleet Age: ~6.5 years*	

*Currently not programmed in CIP

Initial Facility Upgrades Meet MBTA Needs and Pilot BEBs

- Bus Facility Modernization Program is advancing design work and property acquisition to support modernization

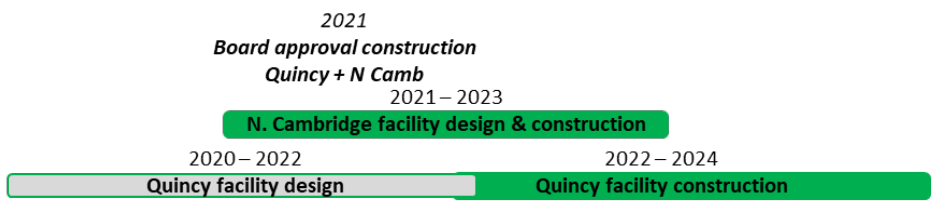
- **Initial priority:** Quincy Bus Maintenance Facility replacement
  - Current facility can only accommodate pre-2010 vehicles
  - Initial investment to support MBTA BEB conversion and expand capacity (86 to 120)
  - 30% design complete; procurement for final design services underway
  - Early construction packages (demolition, roadway reconstruction) could begin in late 2021; major construction activities commence in early 2022; substantial completion late 2024

- **Targeted upgrade:** North Cambridge Carhouse BEB conversion
  - BEB conversion eliminates need to maintain catenary system
  - 30% design phase commencing; Construction could begin end of 2021; ready for BEB service early 2023

- **Additional priorities:** Real Estate and operational needs for Southampton, Arborway, and new West Garage

Full Facility Plan Critical for Electrification, Bus Program Goals

Bus Facilities



Design and construct remaining facilities on a rolling basis. Use additional capacity at new facilities as swing space subsequent facilities (rehabbed, not moved)

Bus Facilities	# Buses	Current Age	Target Replacement	Cost
Quincy	86	95	2024	$280 M*
North Cambridge	28	41	Near-term upgrades: 2023	~$21 M*
Albany	116	79		$1.2 M
Southampton	104	18	TBD (2026 – 2035)	> $3 B
Arborway	118	16	TBD (2026 – 2035)	
Lynn	89	84	TBD (2026 – 2035)	
Fellsway	76	95		
North Cambridge	28	41	Long-term vision TBD (2026 – 2035)	
Albany	116	79		
Cabot	180	45	2037	
Charlestown	254	45	2040	

*Currently not programmed in CIP

New Quincy facility addresses immediate needs and ushers in modern era for MBTA Bus

New facility will:

- **Increase capacity** from 86 up to 120 buses
- Accommodate **both EEH and BEB buses**
- Be a modern, **sustainable facility** with a solar roof and other sustainable features
- Provide state-of-the-art conditions for front-line workers

Project requires $280M for construction added to the CIP

Timeline

ENF and CE under MEPA/NEPA review
30% design submitted in September
Property acquisition early 2021
NTP for final designer by December
Construction starting early 2022 (possible demo/site prep in late 2021)
Opening mid/late 2024

Next Steps

- Replace 32 Silver Line dual-mode bus fleet (8 owned by Massport) with 45 Enhanced Electric Hybrid (EEH) buses for delivery in 2022 (funding identified) – **Board vote expected November 23**
- Quincy Final Design Award presented by Capital Programs – **Board vote expected December 7**
- Release RFP for EEH buses end 2020 (funding identified) – **Board vote expected mid-2021**
- Release RFP by Summer 2021 for delivery of 35 BEB to N. Cambridge in 2023 (funding identified)
- Identify ~$21M for North Cambridge construction in CIP (needed FY 22)
- **Identify funding for longer-term fleet and facilities needs and BEB conversion**

Appendix

How Does MBTA Adoption of BEBs Align with Peers?

New York City Bus
5725 buses
25 BEB today
500 future BEB (*in 5 years*)

Chicago Transit Authority
1864 buses
2 BEB today
20 future BEB

SEPTA
1400 buses
25 BEB today
10 future BEB

King County
1540 buses
10 BEB today
120 future BEB

Toronto Transit Commission
2563 buses
60 BEB today
100/yr future BEB

Most agencies target 100% zero-emissions by 2030-2050. Los Angeles has an aggressive target (100% by 2030), but currently operates only 1.7% of its fleet as BEBs.

New England BEB Experience

Agency	Total Buses (#)	BEB (#)
Worcester Regional Transit Authority	52	6
Martha's Vineyard Transit Authority	37	13
Pioneer Valley Transit Authority	186	3
Rhode Island Public Transit Authority	225	3

BYD
PROTERRA
NEW FLYER
NOVABUS

- PVTA / VTA saved approximately $0.11/mile in fuel costs
- WRTA's BEBs accrued less than 50% of the mileage than non-BEB buses accrued during the same period
- WRTA's BEBs have not saved on maintenance costs and have had reliability issues
- On-site warranty and OEM staff mask actual costs
- Battery range limits BEB deployment on longer routes and in cold climates (advertised range can differ **significantly**)

EEH vs. BEB Operational Summary

	60-foot Traditional Hybrid *Buses #1250-1293 (44 buses)*	60-foot Enhanced Electric Hybrid (EEH) *Bus #1294 (1 bus)*	60-foot Battery Electric Bus (BEB) *Buses #1295-1299 (5 buses)*
Realistic Range	400+ miles	400+ miles	~60 miles at 20°F ambient ~110 miles at 70°F ambient
Re-fuel Time (diesel vs. charging)	20 minutes *Service/fueling at end of day*	20 minutes *Service/fueling at end of day*	3-4 hours 2x per day *BEBs require two charging cycles for a total of 6-8 hours per day to deliver service*
Bus Replacement Ratio	[1:1]	[1:1]	up to [1:1.3] **Dependent on operational changes*
Reliability	Service-proven and reliable	Service-proven and reliable	Significant vehicle and charger reliability issues experienced by MBTA in first year of service
Maintenance Costs	$1.28 per mile	$1.36 per mile	$0.63 per mile **Warranty period and builder support ending; higher unscheduled costs expected in future.*
Operating Costs FY20	$1.19 per mile	$0.82 per mile	$1.46 per mile
Mean Miles Between Failure (MMBF) in Service – FY20	17,863 miles (52 failures recorded)	14,983 (2 failures recorded)	24,913 miles (0 failures recorded) **New Flyer provided significant on-site technical oversight/support during FY 2020;*
Typical Service Day	 **Service** 170+ miles **Fuel** 20 min		 **Service** 60 miles **Charge** 3-4 hrs **Service** 60 miles **Charge** 3-4 hrs

DMA Replacements: Transition Silver Line to Enhanced Electric Hybrids, Expand Southampton

Rationale

- **Average age ~15 years; up to 518k miles per bus**
  - Aging fleet risks service reliability
  - Fleet average 3,415 Mean Miles Between Failures (MMBF) – equates to 1.57 failures every day
- Introduction of modern fleet allows for improved fuel economy
  - EEH replacement of 2004 DMA fleet offers ~8% GHG reduced emissions
- EEH fleet will have 4-wheel drive configuration to support 60’ bus service during snow (same as DMA fleet)
- Replacement parts difficult to procure – builder has been out of business since ~2006
- Eliminating catenary infrastructure offers increased reliability and efficiency in Silver Line Transitway Tunnel

Recommended Action

- **Fleet:** Replace 32 DMA fleet (8 owned by Massport) with 45 Enhanced Electric Hybrid (EEH) buses using available Contract #683 option for delivery in 2022 (funding identified)
  - Increased fleet size supports high density route support, service flexibility, and future expansion
  - Working with Massport on a strategy for funding the enhanced SL service with additional buses
- **Facility:** Thirteen bus increase can be accommodated at Southampton, future real estate options will allow MBTA to better accommodate additional vehicles

ETB Replacement: Pilot BEBs at North Cambridge

Rationale

- **Fleet age 16 years – no mid-life overhaul performed**
  - Fleet average 3,767 Mean Miles Between Failures (MMBF) – equates to 1.87 failures every day
  - Replacement parts difficult to procure – builder has been out of business since ~2006
- Aging and unreliable catenary network is in need of major upgrades/investment or replacement

Recommended Action

- **Fleet:** Release RFP by July 2021 for delivery of 35 BEB to N. Cambridge in 2023 (funding identified)
  - RFP to include an initial option of 50 buses for the new Quincy facility with options available as future facilities come online
  - Maximum operational flexibility; buses are not tied to catenary network
  - Achievable with expanded fleet size to compensate for BEB range limits and upcoming infrastructure upgrade
- **Facilities:** Retrofit North Cambridge with temporary BEB charging infrastructure (construction beginning 2021/2022)
  - Option to fast-track retrofit by running replacement service out of Charlestown during construction
  - Facility upgrades estimated to cost ~$21M (power source from MBTA/Eversource is available)
  - Expedite project with temporary shutdown of North Cambridge, running serve from other garages

Reliance on Overhead Catenary System is Burdensome

In September 2020, MBTA fixed OCS issues on average every two days.

- **Service reliability/inflexibility** – Issues with the OCS and/or roadway disruptions (traffic crashes, etc.) can leave 71/73 passengers stranded until either the Power Department addresses the problem or replacement hybrid buses arrive.
- **Vehicle flexibility** – Replacement service uses traditional buses, straining those fleets, while trolleybuses cannot support Red Line diversion needs like the rest of our fleet.
- **Accessibility and Customer Experience** – The lack of catenary in the heart of Harvard Square results in a need for left side doors, which poses accessibility challenges and confuses riders.
- **Power Department resources** – Maintaining and responding to incidents on the North Cambridge OCS system diverts staff resources from the Green Line.

Maintenance of Trolleybus Overhead Catenary System

6 Month Stats

	71	72	73	77A	Total	[Units]
Events/Month	3	2	2	1	6	[#]
% of Days	10%	5%	7%	4%	19%	[% of Days]
Event Frequency	10	20	14	26	5	[Days Between Events]

On average, the MBTA is servicing catenary lines on a weekly basis

September Stats

	71	72	73	77A	Total	[Units]
Events/Month	12	5	7	1	17	[#]
% of Days	40%	17%	23%	3%	57%	[% of Days]
Event Frequency	3	6	4	30	2	[Days Between Events]

Yet this aging system has the potential to interrupted service on a daily basis.

ECD Replacement: Eliminate Last Fully Diesel Buses from Service Once Facility Improvements are Complete

Rationale

- **Fleet age ~12-14 years – target retirements between 2022 – 2026**
  - 155 buses purchased in 2006 - 2007 (Buses have accumulated up to 558k miles)
  - 155 buses purchased in 2008 - 2009 (Buses have accumulated up to 469k miles)
  - Fleet average 28,685 Mean Miles Between Failures (MMBF) – equates to 1.56 failures every day
- Quincy facility cannot accommodate newer buses due to facility roof height, Quincy facility cannot support expanded fleet due to space limitations
  - Replacing the last 86 buses in this older fleet is dependent on a new Quincy facility being constructed
- ECDs are only remaining exclusively diesel buses in fleet, EEHs demonstrate significant GHG reduction

Ongoing Action

- New Quincy Facility 30% design underway
- Albany facility undergoing minimal alterations to garage door heights to accommodate replacement fleet – **not a long-term strategy**

Recommended Action

- **Fleet:** Release RFP for EEH buses by end of 2020 (funding identified)
  - Base 160 buses delivered in 2022 – 2023 to begin ECD fleet replacement. (Options for additional EEH buses delivered 2024 – 2026)
  - Planning for potential of utilizing BEBs instead of EEHs for last 50+ replacements
- **Facilities:** Replacing this older diesel fleet requires replacement Quincy garage (next slide)