Modernizing Our Bus Fleet and Facilities

Fiscal and Management Control Board
November 9, 2020
Erik Stoothoff
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Increase investment in aging and outdated facilities to accommodate modern buses and support fleet wide electrification, while improving conditions for our workforce.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 and Facilities

#### Bus Procurements
- **2020**: 60-ft EEH NTP
- **2021**: 40-ft EEH NTP
- **2022**: 40-ft BEB NTP
- **2023-2024**: 160x 40-ft EEH
  - 2022: 45x 60-ft EEH
  - 2022-2023: 35x 40-ft BEB
- **2024**: Future Fleet Plan
  - 40-ft BEB or EEH Buses
  - Dependent on Technology and Facility

#### Bus Facilities
- **2020**: Identify high priority corridors
- **2021**: Board approve construction
  - Quincy + N Comb (2021–2023)
  - N. Cambridge facility design & construction (2021–2022)
- **2022**: Board adopt new network
- **2023**: Release BNRD network alternatives for public input
- **2024**: Release BNRD final recommendation
- **2025 and beyond**: Partner BNRD with roadway owners on draft HPCs

#### Bus Transit Priority
- **2020**: Columbus Ave; COVID Rapid response bus lanes
- **2021**: Blue Hill Ave planned
- **2021/2022**: Quincy facility design
- **2022–2024**: Quincy facility construction

#### Bus Network Redesign
- **2020**: Identify high priority corridors
- **2021**: Release BNRD network alternatives for public input
- **2022**: Board adopt new network
- **2022**: Release BNRD final recommendation

### Planning
- **2020**: Columbus Ave; COVID Rapid response bus lanes
- **2021**: Blue Hill Ave planned

### Implementation
- **2020-2022**: Quincy facility design
- **2021-2022**: Quincy facility construction

### Key Decision-Making Point

- **2020**: Identify high priority corridors
- **2021**: Board approve construction
- **2022**: Board adopt new network
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### Bus Transformation Initiatives Timeline

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- **2024**: Release BNRD final recommendation
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**Starting 2022**, Continue evaluating and implementing bus route improvements as travel demand shifts and resources become available.

**Beginning 2020**, Columbus Ave; COVID Rapid response bus lanes

**Beginning 2021**, Blue Hill Ave planned

**2020-2022**, Quincy facility design

**2021-2022**, Quincy facility construction

**2022-2023**, Design and construct remaining facilities on a rolling basis. Use additional capacity at new facilities as swing space for subsequent facilities (rehabbed, not moved)

**2022-2023**, Continue expanding the bus priority infrastructure to further improve bus reliability and enhance rider experience.
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

Move procurement schedule toward a regular purchase and retirement of 80 buses per year
## Bus Fleet and Facilities

### Moving Towards Steady Procurements, Maximum Flexibility

<table>
<thead>
<tr>
<th>Bus Fleets</th>
<th>Fleet Size</th>
<th>Current Age</th>
<th>Target Retirement</th>
<th>Replacement Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neoplan 60-ft Dual Mode</td>
<td>32</td>
<td>14-16</td>
<td>2021 – 2022</td>
<td>$89.4 M</td>
</tr>
<tr>
<td>Neoplan 40-ft Elec Trolley</td>
<td>28</td>
<td>16</td>
<td>2023 – 2024</td>
<td>$52.9 M</td>
</tr>
<tr>
<td>New Flyer 40-ft Diesel</td>
<td>155</td>
<td>13</td>
<td>2022 – 2024</td>
<td>$162.9 M</td>
</tr>
<tr>
<td>New Flyer 40-ft Diesel *</td>
<td>155</td>
<td>11</td>
<td>2024 – 2026</td>
<td>$165 M* (est.)</td>
</tr>
<tr>
<td>New Flyer 60-ft Hybrid</td>
<td>25</td>
<td>10</td>
<td>2024 – 2025</td>
<td></td>
</tr>
<tr>
<td>New Flyer 40-ft Hybrid</td>
<td>60</td>
<td>6</td>
<td>2026 – 2027</td>
<td></td>
</tr>
<tr>
<td>New Flyer 40-ft CNG</td>
<td>175</td>
<td>4</td>
<td>2028 – 2031</td>
<td></td>
</tr>
<tr>
<td>New Flyer 40-ft Hybrid</td>
<td>156</td>
<td>4</td>
<td>2028 – 2031</td>
<td></td>
</tr>
<tr>
<td>New Flyer 60-ft Hybrid</td>
<td>45</td>
<td>4</td>
<td>2028 – 2031</td>
<td></td>
</tr>
<tr>
<td>New Flyer 60-ft Battery Electric</td>
<td>5</td>
<td>1</td>
<td>2031</td>
<td></td>
</tr>
<tr>
<td>New Flyer 40-ft Hybrid</td>
<td>194</td>
<td>1</td>
<td>2031 – 2032</td>
<td></td>
</tr>
<tr>
<td>New Flyer 40-ft Hybrid</td>
<td>60</td>
<td>0</td>
<td>2032 – 2033</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1,090</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Currently not programmed in CIP

Average Fleet Age: ~6.5 years

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**Flexible 40’ Bus Procurements**

- **2022 – 2024**: 160x 40-ft EEH
- **2022-2023**: 35x 40-ft BEB
- **2024**: 40-ft BEB or EEH Buses
  - Dependent on Technology and Facility

**Anticipated $100 - 140M annually**
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
## Bus Fleet and Facilities

### Bus Facilities

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

*Currently not programmed in CIP

Full Facility Plan Critical for Electrification, Bus Program Goals
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**

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

<table>
<thead>
<tr>
<th>Agency</th>
<th>Total Buses (#)</th>
<th>BEB (#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worcester Regional Transit Authority</td>
<td>52</td>
<td>6</td>
</tr>
<tr>
<td>Martha’s Vineyard Transit Authority</td>
<td>37</td>
<td>13</td>
</tr>
<tr>
<td>Pioneer Valley Transit Authority</td>
<td>186</td>
<td>3</td>
</tr>
<tr>
<td>Rhode Island Public Transit Authority</td>
<td>225</td>
<td>3</td>
</tr>
</tbody>
</table>

- 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

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

<table>
<thead>
<tr>
<th></th>
<th>71</th>
<th>72</th>
<th>73</th>
<th>77A</th>
<th>Total [Units]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Events/Month</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>6 [#]</td>
</tr>
<tr>
<td>% of Days</td>
<td>10%</td>
<td>5%</td>
<td>7%</td>
<td>4%</td>
<td>19% [% of Days]</td>
</tr>
<tr>
<td>Event Frequency</td>
<td>10</td>
<td>20</td>
<td>14</td>
<td>26</td>
<td>5 [Days Between Events]</td>
</tr>
</tbody>
</table>

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

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

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)