REVENUE VEHICLES

PROGRAM OVERVIEW

The revenue vehicle fleet is one of the most visible and important components of the MBTA service network. These are the trains, buses, and other vehicles that passengers board every day. The MBTA’s fleet is composed of approximately 2,500 revenue vehicles as detailed below.

The MBTA adheres to a general standard lifecycle of 35 years for rapid transit and light rail vehicles, 25 years for commuter rail locomotives, 25 to 30 years for commuter rail coaches, and 15 years for buses. Scheduled major overhauls, maintenance, and planned retirements help these fleets reach their useful life, and prevents the unwarranted consumption of resources to maintain their reliability.

The current program devotes $946.7 million to revenue vehicles, primarily for fleet procurement and overhaul programs. The revenue vehicle program represents 35.0% of the total Capital Investment Program, the largest share of any programmatic area, and is composed primarily of reinvestment in the subway system and the bus fleet. In keeping with the MBTA’s commitment to

Revenue Vehicles Funding

- Other Capital Investments: $1,754.7m (65.1%)
- Revenue Vehicles: $946.7m (35%)
- Commuter Rail: $357.2m (13.2%)
- Subway: $356.6m (13.2%)
- Bus & RIDE: $227.7m (8.4%)
- Ferry: $5.22m (0.2%)
upgrade its bus service, ongoing projects are bringing 360 new CNG vehicles, 28 new electric
trolley buses, 348 new emission-control diesel buses, and 32 dual-mode buses to the MBTA
system in the next few years. These fleets will permit the retirement of hundreds of aging
diesel buses purchased in the 1980s. Other efforts in this program also include major
component replacements on the Green, Orange, and Red Lines. Furthermore, the purchase of
100 new cars for the Green Line and 94 new cars for the Blue Line will modernize and expand
these existing subway fleets.

Activity within the commuter rail vehicle program includes major midlife overhauls for large
portions of the locomotive and coach fleets. It is anticipated that the commuter rail fleet needs
will represent a more significant portion of the Capital Investment Program in the future.

REVENUE VEHICLES—SUBWAY

The MBTA subway system consists of four transit
tlines, three are Rapid Transit and one is Light
Rail. The rapid transit lines are the Red, Blue,
and Orange lines. While, the Light Rail Line is
referred to as the Green Line. Each of the lines
with has a distinct fleet of vehicles and each fleet
is assigned a number by the MBTA.

The Red Line fleet is made up of two hundred
and eighteen (218) cars of three separate fleets.
They include seventy-four (74) Pullman Standard
No. 1 cars, fifty-eight (58) UTDC No. 2 cars, and
eighty-six (86) Bombardier No. 3 cars. Preventive maintenance inspections occur every 8,500
miles for the No. 1 and No. 2 cars, and every 15,000 miles for the No. 3 cars.

The Blue Line fleet is comprised of seventy (70) Hawker-Siddeley No. 4 cars. Preventive
maintenance inspections occur every 7,500 miles. However, due to the salt air of the
environment in which they operate, these cars are scheduled for retirement before the
standard useful life. In early 2006, the Blue Line will start receiving the new Siemens No. 5
cars. This process will last until the end of 2007, at which point the Blue Line will have a fleet
size of one hundred and twelve (112). Consisting of ninety-four (94) No.5 cars and eighteen
(18) No. 4 cars that will be kept in service.

The Orange Line fleet consists of one hundred twenty (120) Hawker-Siddeley No. 12 series
cars. Preventive maintenance inspections occur on a 90-day interval.

<table>
<thead>
<tr>
<th>MBTA Subway Revenue Vehicle Fleets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Line</strong></td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>Red</td>
</tr>
<tr>
<td>Blue</td>
</tr>
<tr>
<td>Orange</td>
</tr>
<tr>
<td>Green</td>
</tr>
<tr>
<td>Green</td>
</tr>
<tr>
<td>Green</td>
</tr>
<tr>
<td>Green</td>
</tr>
</tbody>
</table>
The Green Line fleet is made up of one hundred and eighty-three (183) light rail vehicles (LRVs) with three separate fleets: thirty (30) Boeing LRVs, one hundred and twelve (112) Kinki-Sharyo No. 7 cars, and forty-one (41) Breda No. 8 cars. The Green Line also maintains ten (10) active Presidents’ Conference Committee (PCC) cars, which is the oldest fleet on MBTA property. The procurement of 100 No. 8 low-floor vehicles is currently underway and will enable the retirement of the Boeing fleet, thus increasing the fleet size of the Green Line. The No. 8 cars are currently being introduced into service incrementally, and 42 have been conditionally accepted. The Boeing LRVs have a light inspection every 4,500 miles and a heavy inspection at 9,000 miles. The No. 7 cars are inspected at 5,500-mile intervals. While, the PCC cars are inspected on a 30-day basis.

Subway rolling stock generally has a useful life cycle of 35 years or more. The MBTA subscribes to a philosophy of ongoing preventive maintenance for light rail and heavy rail vehicles. This approach keeps the vehicles safe and reliable at a reasonable cost. Preventive maintenance will be needed for repairing major components such as floors, pantographs, couplers, or overhead blower motors.

The majority of the subway vehicle capital program is designated for the procurement of new fleets for the Green and Blue Lines. The Orange, Red, and parts of the Green Line fleets are undergoing major capital component replacements and overhauls.

**Funded Projects**

The ten approved projects in the subway vehicle program will replace vehicle fleets on the Green and Blue lines, perform major overhauls and component replacements for four vehicle fleets, and supply the remaining fleets with minor component overhauls and preventive maintenance. All of these projects listed below (with the exception of the two procurements) represent preventive maintenance and will have a neutral effect on the operating budget. The No. 8 procurement will increase the Green Line fleet by 20% and the new Blue Line car procurement will increase the Blue Line fleet by 35%, resulting in higher operating and maintenance costs.

☑️ **Red Line No. 1 Car Reinvestment**
This project, currently in process, is performing a component exchange on the Red Line No. 1 cars to ensure continued vehicle reliability and to extend vehicle service life.

☑️ **Red Line No. 2 Car Overhaul**
The purpose of this project is to perform a full midlife overhaul of the No. 2 vehicles. This program will maintain major systems in a state of good repair and ensure the vehicle fulfills its useful life.

☑️ **Red Line No. 3 Car Upgrade**
This project will fund the procurement, removal, and reinstallation of lithium batteries, including the replacement of the controller circuit cards and related software. In addition, the project will replace the monitoring terminal units (MTUs) in control cars. This will ensure the reliability of the No. 3 vehicle fleet.

☑️ **Green Line Low Floor Cars (No. 8) Procurement**
This project encompasses the procurement of 85 new low floor Green Line (No. 8) cars with spares. This investment also includes the modification of the existing No. 7 fleet to allow the No. 7 and No. 8 cars to operate together. This effort will make the Green Line accessible for disabled passengers and increase the overall size and capacity of the fleet.

☑️ **Green Line No. 7 Car Midlife Overhaul**
This project encompasses a number of component repair and replacement efforts for the Green Line No. 7 fleet. The scope includes replacing and adjusting the obstruction-sensing system on the car doors, modifying the wheel profile to minimize wear on the
track, upgrading and repairing the coupler support rods and spherical bearings, reengineering and upgrading the brake actuators, and replacing vehicle roofs. This project is an expansion of the No 7 Fleet modification program.

☑ Orange Line Cars Capital Reinvestment
This project funds the overhaul of the suspension system and the replacement of the propulsion cam controllers for the entire Orange Line fleet. This will ensure continued vehicle reliability and allow the vehicles to reach their full service life.

☑ Orange Line No. 12 Car Rebuild—Phase II
This project involves a component overhaul for the No. 12 cars, including a structural sill repair effort that will ensure continued vehicle reliability. The project also examines a long-term strategy for maintaining the Orange Line fleet in a state of good repair.

☑ Blue Line Fleet Procurement
This includes the purchase of 94 new Blue Line cars, allowing for six-car train serves and increased capacity on the Blue Line. The procurement will increase the overall size of the Blue Line fleet and will offer better service, passenger comfort, and reliability.

☑ Orange Line Fleet Procurement
This project will fund the design of the next generation vehicle for the Orange Line. In addition, the Authority will use elements of this design for the procurement of replacement No. 1 cars on the Red Line.

☑ Subway Vehicle Paint Program
This project involves the preparation and painting of a number of rapid transit vehicles. The project is intended to restore vehicle appearance and involves some necessary bodywork. This action assists the vehicles in attaining their normal life expectancy.

---

### Subway Revenue Vehicles Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
<th>Total FY07-11</th>
<th>BEYOND FY11</th>
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<tbody>
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<td>Red Line No. 1 Car Reinvest.</td>
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<td>$2.13</td>
<td>$1.68</td>
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<td>$3.80</td>
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<td>Red Line No. 2 Car Overhaul</td>
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<td>24.96</td>
<td>0.04</td>
<td>66.00</td>
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<td>Red Line No. 3 Upgrade</td>
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<td>0.89</td>
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<tr>
<td>Orange Line Cars Rebuild II</td>
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<td>Blue Line Fleet Procurement</td>
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<td>Orange Line Fleet Procurement</td>
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<td>4.00</td>
<td>4.00</td>
<td>10.00</td>
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</tr>
<tr>
<td>Subway Vehicle Paint Prgm.</td>
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<td>1.49</td>
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<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td><strong>Total Subway Vehicles</strong></td>
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<td><strong>$287.46</strong></td>
<td><strong>$92.47</strong></td>
<td><strong>$95.17</strong></td>
<td><strong>$87.95</strong></td>
<td><strong>$50.96</strong></td>
<td><strong>$30.04</strong></td>
<td><strong>$356.59</strong></td>
<td><strong>$0.00</strong></td>
</tr>
</tbody>
</table>

**ANTICIPATED FUTURE NEEDS**

To date, the MBTA has identified the following subway vehicle projects as future needs.

☐ Red Line No. 1 Replacement Fleet
New cars will be needed to allow the retirement of the No. 1 fleet.

☐ Orange Line Fleet Procurement
Procurement of new cars will be needed to allow the retirement of the No. 12 fleet.
REVENUE VEHICLES—COMMUTER RAIL

The commuter rail fleet consists of 377 passenger coaches and 80 locomotive units. There are four series of coaches: the Pullman Standard fleet, the MBB fleet, the Bombardier fleet, and the Kawasaki fleet. The coach fleets are detailed below:

- 57 Pullman coaches (1979); this fleet was over-hauled in 1995-96.
- 67 Messerschmitt-Bolkow-Blohm (MBB) coaches (1987-88). These cars are the only MBTA coaches equipped with toilet facilities. It is MBTA policy for every trainset to include one car with a functioning toilet system.

The revenue locomotive fleet is composed of 80 units of four major types:

- 18 model F40PH-2 locomotives (1978, 1980); this fleet was upgraded in 1989-90.
- 25 model F40PH-2C locomotives (1987-88); a midlife overhaul is in process.

Locomotives and coaches are typically considered to have a useful life cycle of 25 to 30 years. Generally, top-deck overhauls are scheduled for locomotives on a 6 to 6.5 year schedule. Vehicle mid-life overhauls are usually conducted at 12.5 years and are designed to enable the vehicles to reach their full service life in terms of power performance and dependability. Locomotives and coaches are typically scheduled for replacement after the vehicles have reached their 25 to 30-year life expectancy.

The majority of the commuter rail vehicle programmed spending is devoted to major overhaul efforts for the locomotive and coach fleets.

<table>
<thead>
<tr>
<th>MBTA Commuter Rail Revenue Vehicle Fleets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty. Fleet Type</td>
</tr>
<tr>
<td>------------------------------------------</td>
</tr>
<tr>
<td>57 Pullman Coaches</td>
</tr>
<tr>
<td>67 MBB Coaches</td>
</tr>
<tr>
<td>40 Bombardier A Cars</td>
</tr>
<tr>
<td>106 Bombardier B Cars</td>
</tr>
<tr>
<td>18 F40PH-2 Locomotives</td>
</tr>
<tr>
<td>12 F40PH-2M Locomotives</td>
</tr>
<tr>
<td><strong>457 Total</strong> (377 Coaches, 80 Locomotives)**</td>
</tr>
</tbody>
</table>

FUNDED PROJECTS

Capital projects for commuter rail vehicles include procurement and overhaul of locomotives and coaches. Procurements of new coaches for the Greenbush Commuter Rail project are listed in the System Expansion section of this document. The overhaul projects represent normal preventive maintenance and will have a neutral impact on the Authority’s operating budget.
Commuter Rail Locomotives Midlife Overhaul:

**F40PH-2C Midlife Overhaul (25)**
This effort represents a standard midlife overhaul for 25 F40PH-2C locomotives. The overhaul will recondition the fleet for passenger safety and efficiency.

**F40PH-2M Midlife Overhaul (12)**
This effort consists of a standard midlife overhaul of 12 F40PH-2M locomotives. The overhaul will recondition the fleet for passenger safety and efficiency.

Commuter Rail Locomotives Top Deck Overhaul:

**F40PH-2/GP40-MC Locomotives (18/9)**
This project involves a top deck overhaul for 18 F40PH-2 and 9 GP40-MC locomotives. The overhaul will recondition both fleets for passenger safety and efficiency.

**GP40-MC Locomotives (16)**
This effort will overhaul the 16 remaining GP40-MC locomotives. Work consists of replacing rotating equipment such as power assemblies, turbochargers, camshafts, fuel injectors, pump compressors and fans. The completion of this overhaul will improve the service reliability of these units, help maintain on-time performance standards, and increase operating efficiency by reducing the number of failures.

**F40PH-2M Locomotives (12)**
A top deck overhaul is scheduled for 12 F40PH-2M locomotives. Work consists of replacing rotating equipment such as power assemblies, turbochargers, camshafts, fuel injectors, pump compressors and fans. The completion of this overhaul will improve the service reliability of these units, help maintain on-time performance standards, and increase operating efficiency by reducing the number of failures.

**F40PH-2C Locomotives (25)**
A top deck overhaul is scheduled for 25 F40PH-2C locomotives. Work consists of replacing rotating equipment such as power assemblies, turbochargers, camshafts, fuel injectors, pump compressors and fans. The completion of this overhaul will improve the service reliability of these units, help maintain on-time performance standards, and increase operating efficiency by reducing the number of failures.

Passenger Coach Reliability and Safety Maintenance Program
This project funds the overhaul of various aspects of the Authority’s coach fleet. To be included in this overhaul program are critical safety components such as trucks, brakes, couplers, and draft gears, in addition to others such as air conditioning systems and toilets. The program will encompass approximately 360 coaches of the entire 377-vehicle passenger coach fleet.

Locomotive Procurement
This project funds the procurement of 38 locomotives, which will replace portions of the existing fleet while reducing emissions.

Coach Procurement
This project funds the procurement of 75 bi-level coaches. This project will allow the Authority to retire a portion of the coaches fleet while increasing commuter rail passenger capacity.
**Kawasaki Coach Overhaul (75)**
This project funds the full midlife overhaul of Kawasaki coaches. The overhaul work includes replacing and reconditioning trucks, couplers, HVAC system, electrical system, batteries and battery chargers, some interior fixtures and safety-emergency equipment.

**New Locomotive Equipment Procurement (25)**
This project involved purchasing 25 reconditioned locomotives to supplement the existing locomotive fleet. The locomotives are currently in service; the current funding is for contract warranty.

### Commuter Rail Revenue Vehicles Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
<th>FY07-11</th>
<th>BEYOND FY11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotive Midlife Overhaul</td>
<td>$43.54</td>
<td>$42.37</td>
<td>$1.17</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$0.00</td>
<td>$1.17</td>
<td>$0.00</td>
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<tr>
<td>Locomotive Top Deck Ovrhl.</td>
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<td>4.15</td>
<td>6.11</td>
<td>5.05</td>
<td>1.07</td>
<td>0.00</td>
<td>0.00</td>
<td>12.23</td>
<td>0.00</td>
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<tr>
<td>Pass. Coach Mntce. Prgm.</td>
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<td>5.02</td>
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<td>11.60</td>
<td>9.60</td>
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<tr>
<td>Locomotive Procurement</td>
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<td>CR Coach Procurement</td>
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<td>Kawasaki Coach Overhaul</td>
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<tr>
<td>New Locomotive Proc.</td>
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<tr>
<td><strong>Total Commuter Rail Vehicle</strong></td>
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<td><strong>$84.03</strong></td>
<td><strong>$18.90</strong></td>
<td><strong>$30.15</strong></td>
<td><strong>$93.43</strong></td>
<td><strong>$79.75</strong></td>
<td><strong>$135.00</strong></td>
<td><strong>$357.22</strong></td>
<td><strong>$74.00</strong></td>
</tr>
</tbody>
</table>
REVENUE VEHICLES—SILVER LINE

The MBTA is constructing the new Silver Line, a new Bus Rapid Transit (BRT) system with service from Dudley Square, through downtown, South Station, the South Boston Seaport District, and to Logan Airport, in three distinct phases. When complete, the Silver Line will provide connections between Roxbury, job centers downtown, South Station, South Boston, and Logan Airport. The service will also be coordinated with Massport to provide service to Logan Airport. Phase I, with service along Washington Street from Dudley Square in Roxbury to downtown Boston, opened in July 2002. Phase II, with initial service from South Station to the South Boston Seaport District, and with eventual service to Logan Airport, the new convention center, and the Boston Marine Industrial Park via a tunnel under Fort Point Channel, opened in December 2004. Phase III, the tunnel connecting the first two portions, is anticipated to be complete in 2010.

A mixed fleet of 60-foot NeoPlan articulated Compressed Natural Gas (CNG) buses and 40-foot New Flyer CNG buses currently provides service to Phase I of the Silver Line downtown and along the exclusive bus-only lane along portions of Washington Street to Dudley Square. As the delivery of all 17 of the 60-foot NeoPlan buses continues, the New Flyer fleet will transition from the Silver Line to regular bus service (described in the Bus Revenue Vehicles section of this document).

The 60-foot NeoPlan articulated buses, acquired in 2003-2004, are powered by clean-burning compressed natural gas, equipped with low floors for easy boarding, and are air-conditioned. These vehicles are expected to have a useful life of 12 to 15 years. They are equipped with “smart” location message signs and audio announcements, capable of informing passengers of their location, the destination of the bus, the next station stop, intermodal transfers, and other useful information.

The Phase II portion of the Silver Line will operate 32 dual-mode, diesel-electric, 60-foot articulated buses in the tunnel from South Station to South Boston and Logan Airport. Since these new fleets will be providing a new service, they are described in the System Expansion section of this document.

FUNDED PROJECT

The only project in the Silver Line revenue vehicles program is the ongoing procurement effort for the Washington Street portion (Phase I) of the Silver Line. These vehicles are in service, and the project represents closeout costs and warranty service. This project has a neutral impact on the Authority’s operating budget.

Washington Street Replacement Vehicles (Phase I)
This procurement project consists of 17 CNG powered 60-foot articulated, low floor accessible vehicles to provide Silver Line service between Dudley Square and downtown Boston. The new vehicles have the ability to provide automatic vehicle location information, via a Global Positioning System (GPS) unit, to onboard passengers and to the Bus Operations Control Center to ensure frequent service and proper spacing between vehicles.
### Silver Line Revenue Vehicles Project ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
<th>Total FY07-11</th>
<th>BEYOND FY11</th>
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<tr>
<td>Wash. St. Vehicles (Ph I)</td>
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<td>Total Silver Line Vehicles</td>
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<td>$0.00</td>
<td>$0.00</td>
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### ANTICIPATED FUTURE NEEDS

The Authority anticipates the following additional vehicle procurements and maintenance projects for Silver Line Phase II.

- **Silver Line Vehicle Midlife Overhaul**
  The MBTA anticipates programming a midlife CNG overhaul for the 17-vehicle fleet currently operating on Phase I of the Silver Line.

- **Silver Line Phase II South Boston Transitway Vehicle Procurement**
  The Authority has a contractual option to purchase 32 additional vehicles for the Silver Line Phase II.

- **Silver Line Phase III Vehicles**
  After the completion of the Silver Line, additional vehicles may be needed to provide full service.
REVENUE VEHICLES—FERRY BOATS

The MBTA’s will continue focus on system reinvestment. This effort also includes the replacement of vessels that operate our Boston Harbor service. The MBTA operates commuter boat service on several routes between Boston, various points in the inner Boston Harbor, and three terminals on the South Shore. Two of the operating ferry boats are owned by the Authority, while the rest are provided by outside service contractors. Ferry terminals are located in Hull, Hingham Shipyard, Fore River Shipyard in Quincy, Logan Airport, World Trade Center, Courthouse, Rowes Wharf, Long Wharf, Lovejoy Wharf, and the Charlestown Navy Yard.

FUNDED PROJECTS

The spending in the 2 approved projects is for the procurement of replacement vessels.

☑ MBTA Ferry System
This project involves the procurement of a replacement vessel for the MBTA’ ferry boat service.

☑ Catamaran for Quincy Harbor
This new procurement will buy a catamaran for the Authority’s Quincy Harbor service.

Ferry Revenue Vehicles Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
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REVENUE VEHICLES—BUS

One the MBTA’s priorities are to improve bus service, and this priority is reflected in the magnitude of current capital investment in bus fleets. By 2006, almost two-thirds of the bus fleet will be replaced with 631 new vehicles, hundreds of diesel buses from the 1980s have been retired, and the remaining fleets are undergoing a thorough overhaul. This program includes vehicles in the MBTA’s bus, trackless trolley and paratransit services (THE RIDE). The MBTA’s bus and trackless trolley service operations consist of over 200 routes. THE RIDE, a demand-responsive service for individuals with mental and physical disabilities, provides accessible service to 62 cities and towns in the MBTA service district.

The MBTA’s bus fleet currently consists of 993 active buses: 360 compressed natural gas (CNG) low-floor buses, 193 emission-control diesel buses, 371 ultra low-sulfur diesel buses, 47 trackless trolley vehicles, 2 prototype alternative fuel buses, and 20 dual mode articulate buses. The older trackless trolley fleet of 19 vehicles is being replaced incrementally by the 28 new Electric Trolley Buses. Almost two-thirds of the bus fleet has been replaced since 2001 with new vehicles with low floors for easy boarding, “smart” bus location message signs and audio announcements, and environmentally-friendly propulsion systems to reduce emissions. The average age of the bus fleet, 14 years in 2003, has dropped to almost 4 years of age in 2005. In short, the MBTA’s goal is to improve its bus fleet through new equipment, customer service initiatives, and increased reliability.

All 40-foot coaches and CNG vehicles have a 15-year useful life, and trackless trolleys have a 20-year useful life. All new buses operate on clean compressed natural gas or emission-control ultra-low sulfur diesel (ECD) engines, which are the most cost-effective and environmentally friendly propulsion technologies for the MBTA fleet. In addition, 453 vehicles for THE RIDE with useful lives of 5-7 years are included in the bus revenue vehicle fleet. Below is a roster of the MBTA’s bus fleets:

2004 North American Bus Industries (NABI) CNG Buses
This fleet of 299 buses, which entered service in 2004, are fueled by clean-burning compressed natural gas, are air-conditioned, and will offer low floors for easy boarding. These vehicles have allowed the Authority to replace hundreds of 1980s-vintage diesel buses.

2004 NeoPlan Emission-Controlled Diesel (ECD) Buses
This group of 193 buses also entered service in 2004, completing the retirement of buses purchased in the 1980s. This fleet is fueled by efficient engines running on ultra-low sulfur diesel fuel. Based on initial success of these buses, the Authority increased the initial 175 units by exercising its option for an additional 18 buses for a total of 193 low floor ECD buses.

2003 NeoPlan 60-foot Articulated CNG Buses
This 44-bus fleet entered service in 2003 and 2004. These low-floor buses are 60 feet long and offer more seats and expanded capacity compared to a traditional 40-foot bus.

2002 New Flyer Compressed Natural Gas Buses
These 17 40-foot buses were initially deployed on Phase I of the Silver Line, and they are currently being shifted to operate on standard bus routes.

1995 “Zero-Series” Nova RTS
This 40-foot bus fleet is composed of 258 vehicles, with each bus equipped with wheelchair lifts and air conditioners. The fleet is undergoing an extensive overhaul program.
1994 “Zero-Series” TMC RTS
This 40-foot series is composed of 113 vehicles, which are equipped with both wheelchair lifts and air conditioning. The fleet is undergoing an extensive overhaul program.

2003 Prototype Alternative Fuel
In 2003, the Authority procured two (2) buses to test new propulsion technology. Bus Operations is proposing to convert the two buses for use as instruction and training buses.

2004 NeoPlan Electric Trolley Buses
This new fleet of 28 new trackless trolleys incorporates the new technology of smart bus features, a propulsion system powered by overhead catenary wires, and a low-floor design to accommodate all riders.

1976 Flyer Trackless Trolleys
The trackless trolley fleet includes 19 electric trolley buses, procured in 1976. The trolleys have attained their service life expectancy and will be replaced with a fleet of 28 electric trolley buses (above).

2004/2005 NeoPlan 60ft Dual-Mode Articulated Buses
This new fleet of 20 vehicles is in service supporting Phase 2 of the Silver Line’s Transitway and Airport Intermodal Transit Connector (AITC) with the Logan Airport facilities. The Authority, under FTA’s guidance, entered a joint procurement arrangement with Massport for 8 of the 32 vehicles, to provide service to Boston’s Logan Airport. The Authority will perform maintenance and operations of the vehicles under a separate agreement with Massport. The fleet is powered by two 161 Hp Skoda Energo AC traction motors. Electrical power is provided from 600 vdc overhead wires in the transitway tunnel, and from a 746 kW Kaman Generator when on surface streets. The generator is driven by an emissions controlled, 500 Hp, Detroit Diesel, Series 60 Engine running on ultra low sulfur diesel fuel with a diesel particulate filter.

<table>
<thead>
<tr>
<th>MBTA Bus Revenue Vehicle Fleets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qty</td>
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<tr>
<td>-----</td>
</tr>
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<td>44</td>
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<td>2</td>
</tr>
<tr>
<td>20</td>
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<td>993</td>
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</table>

The MBTA’s maintenance strategy for the bus program is characterized by continuous and frequent preventive maintenance inspections, along with immediate, complete repairs of all defects using new parts. Part replacement is on a programmed schedule to prevent complete component failure. Power train overhauls are completed every 250,000-300,000 miles. This effort maximizes vehicle and component utilization by employing advanced preventive maintenance practices.
THE RIDE
The Authority’s paratransit program, THE RIDE, has a fleet of 225 sedans and 228 lift-equipped vans. The MBTA owns 66% of the fleet, which consists of 174 sedans (with a useful life of five years) and 126 vans (with a useful life of six years). The remaining 153 vehicles are owned and maintained by four private firms.

FUNDED PROJECTS
The majority of spending in the 12 approved projects in the bus program is for the purchase of new buses and trackless trolleys. While most of these projects, including emission-controlled diesel buses, will have a neutral impact on operating costs, the CNG buses will have a negative impact on operating costs due to increased fuel and required maintenance costs.

☑ 27 NeoPlan 60-foot Articulated CNG Buses
This project involves the procurement of 27 60-foot articulated CNG-fueled buses. These buses, which began entering service in 2003, offer expanded seating capacity, high quality service, and run on environmentally-friendly low emissions technology.

☑ Bus Replacements Phase I: 18 New Emission-Controlled Diesel (ECD) Buses
This new procurement will buy a new fleet of ECD buses to begin the programmatic replacement of the “zero-series” fleet. These buses are now the only MBTA buses that predate 2001, and this project is the first phase in the retirement of the fleet.

☑ Bus Replacements Phase II: 155 New Emission-Controlled Diesel (ECD) Buses
This new project will procure an additional fleet of up to 134 vehicles to continue the programmatic replace of MBTA buses in future years.

☑ Bus Replacements Phase III: 140 New Emission-Controlled Diesel (ECD) Buses
This new project will procure an additional fleet of up to 140 vehicles to continue the programmatic replacement of MBTA buses in future years.

☑ 299 North American Bus Industries 40-foot Compressed Natural Gas Buses
This major project has purchased 299 CNG-fueled buses, which have been entering service in two phases. This project now consists of mostly closeout costs.

☑ 175 NeoPlan 40-foot Emission-Control Diesel (ECD) Buses
This bus procurement effort included 175 new 40-foot buses. This project now consists of mostly closeout costs.

☑ 28 NeoPlan Electric Trackless Trolleys
The project involves the procurement of 28 electric trackless trolleys to replace the existing fleet of Flyer vehicles. The new fleet, which is partially in revenue service, will incorporate the new technology of “smart bus” features, along with low-floor design to accommodate all riders.

☑ ”Zero Series” Bus Midlife Overhaul
The bus fleets purchased in 1994 and 1995, also known as the “zero-series” buses, will receive thorough overhauls and strict maintenance as they remain in active service during a staggered phase-out and replacement. This project will provide funding for midlife overhauls on the buses in the fleet, consisting of a full component overhaul or lighter structural work, depending on vehicle condition and need. The rehabilitation work will be performed to improve vehicle structure, mechanical systems, wheelchair lifts, electrical systems and bodywork, and will improve service reliability and passenger comfort.
**REVENUE VEHICLES**

☑ **17 New Flyer 40-foot Compressed Natural Gas Buses**

These 17 buses, initially deployed on Phase I of the Silver Line, are currently being shifted to operate on standard bus routes. They are 40 feet long, air conditioned, low-floor for easy boarding, and outfitted with “smart” location message signs and audio announcements.

☑ **2004-2005 Bus Fleet Rehab**

This project will fund the overhaul of all buses procured through 2005.

☑ **Bus Technology Initiatives**

This project entailed the purchase and evaluation of 2 prototype alternative fuel buses. These buses will help the Authority in evaluating technologies for future fleet replacement.

☑ **THE RIDE Vehicle Program**

The Authority has the option to allocate capital funds to procure a fleet of accessible paratransit vans and sedans.

### Bus Revenue Vehicles Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
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**ANTICIPATED FUTURE NEEDS**

Given the age of the existing fleet, current bus purchases will result in a large influx of new vehicles. In the future, however, the MBTA intends to program bus vehicle purchases to allow the Authority to receive a small number of buses at a constant rate. This strategy will reduce the Authority’s mechanical dependency on a single class of vehicles, and will keep the average bus age relatively constant over time. The following projects have been identified as anticipated future needs.

☐ **Continue “Zero-Series” Fleet Replacement**

In the long term, additional new buses beyond the purchases programmed here are anticipated to continue the future retirement of the fleet of “zero-series” buses, which are currently undergoing a program of midlife overhauls, maintenance, and replacement. It is anticipated that the MBTA will continue to purchase these buses in a gradual manner to complete a staggered phase-out of the fleet over several years in conjunction with the ongoing overhaul effort, and based on the need and condition of the remaining fleets.
NON-REVENUE VEHICLES

PROGRAM OVERVIEW

To respond to emergencies, perform maintenance work, keep the system safe for passengers, and to engage in major construction work, the MBTA operates a large fleet of vehicles and work equipment not used to transport passengers. Maintenance service calls, safety-critical situations, field supervision, revenue collection, repair projects, and system upgrade efforts occur all over the MBTA’s service district and metropolitan Boston. Non-revenue vehicles and equipment support the entire range of Authority operations.

Therefore, the MBTA owns and operates a large fleet of 949 non-revenue vehicles. This wide array of vehicles varies greatly, and includes rail-mounted and rubber-tired cars, trucks, sedans, police cruisers, snow plows, track geometry cars, brush cutters, and spreaders. Included in the maintenance-of-way category are crane, bucket, cable, platform, and snow fighting trucks. Rubber-tired construction equipment includes front-end loaders, backhoes, cranes, and other vehicles.

In addition to vehicles, the MBTA also owns and maintains non-revenue equipment. These include loaders, trailers, pumps, tractors, air compressors, portable light plants, and other equipment.

Non-revenue vehicles will be part of a systemwide fleet plan for prioritizing the replacement and capital maintenance needs to keep the fleet in a state of good repair. The Authority will invest $17.6 million for non-revenue equipment in the current capital program.
SYSTEMWIDE NON-REVENUE VEHICLES

Non-revenue vehicles used to maintain the infrastructure supporting the MBTA’s transit services, rights-of-way, signals, power, and other equipment include rail-mounted (or on-track) machines such as GLP (generator, lift, and pump) cars, emergency response vehicles, track geometry cars, dump cars, wire cars, flat cars, cranes, tampers, box cars, ballast regulator cars, tie handlers, brush cutters, and clearance cars. These vehicles have various service lives, ranging from 7 years to 20 years. The ability to perform maintenance, respond quickly to service problems, and to react to safety issues is critical, and the condition of the fleet that supports these activities is a major component for success.

Rapid Transit Work Cars
MBTA operations and maintenance personnel employ 46 assorted rapid transit work cars: box cars, re-railing cars, clearance cars, cranes, flat cars, snow plows, and wire cars. The useful life of these cars ranges from 7 to approximately 40 years.

Commuter Rail Work Cars
The Authority’s commuter rail service provider, Massachusetts Bay Commuter Rail, operates 333 non-revenue vehicles, including hi-rail trucks, snow plows, and pickup trucks, as well as maintenance-of-way equipment.

Bus Operations, Construction, and Systemwide Vehicles
Bus Operations maintains a pool of 570 assorted vehicles for signal crews, power maintenance personnel, track crews, and administrative functions. In addition, this pool includes heavy construction machinery used by the Design and Construction Directorate, and bus tow trucks capable of towing 40- and 60-foot buses.

MBTA Police Department Vehicles
The MBTA Police Department utilizes a fleet of approximately 100 police cruisers, motorcycles, and other safety equipment.

FUNDED PROJECTS

Given the size and complexity of the non-revenue vehicle and equipment inventory, the Capital Investment Program allocates funds to a systemwide plan for programming the normal replacement of equipment over its life cycle. These funded projects represent normal replacement of assets and will have a neutral impact on the operating budget.

- **Systemwide Non-Revenue Vehicle Program**
  Based on a comprehensive fleet plan that prioritizes future ongoing replacement needs for all modes, this project provides funding for the fleet of nearly 1,000 systemwide non-revenue vehicles and equipment.

- **Subway Operations Non-Revenue Equipment Procurement**
  This effort will procure non-revenue subway equipment, including re-railing trucks for the Orange and Red Lines and a wheel profiler for the Green Line.

- **Systemwide Maintenance Improvement Equipment**
  This project will fund the procurement of a production tamper, which will allow the Authority to maintain and increase system reliability.
Snow Fighting Equipment
This project will allow the agency to replace all its aging snow fighting equipment, which has passed its useful life.

Police Fleet Modernization
This effort provides funds for the MBTA Police Department to replace police cruisers and other safety equipment to maintain its capital infrastructure in a state of good repair.

Systemwide Non-Revenue Vehicles Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
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<th>FY11</th>
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<tr>
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<td>$1.48</td>
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</table>

ANTICIPATED FUTURE NEEDS

The ability of the Authority to maintain the transit system, respond to service problems, and to react to and correct safety issues is critical, and the condition of the fleet that supports these activities is a major component for success. The current fleet is composed of some vehicles that have reached their service lives and are due for replacement. These needs will be prioritized and addressed within the systemwide non-revenue vehicle fleet program.

Systemwide Non-Revenue Vehicle Needs
This project would continue funding efforts under the systemwide fleet plan to meet ongoing needs.

Commuter Rail Non-Revenue Vehicle Needs
The replacement of six aging non-revenue vehicles and light trucks used by the MBTA staff in the inspection of commuter rail equipment is anticipated. The replacement of approximately 45 maintenance-of-way (MOW) work vehicles will also need to be programmed.

Replacement of MOW Work Equipment
Replacement of maintenance-of-way work cars and equipment is anticipated as they reach or exceed their useful life. This equipment includes tie replacement, snow removal, brush cutting, track geometry inspection, excavating and other maintenance support equipment.
TRACK/ RIGHT-OF-WAY

PROGRAM OVERVIEW

The MBTA currently operates light and heavy rail transit on 185 miles of track. The commuter rail system is operated on 600 miles of track. On each rail line, replacement efforts are programmed for different segments based upon geographical location or type of track construction.

The right-of-way generally consists of the actual steel rails of the track, rock or dirt ballast that acts as the flat foundation for the track, and concrete or timber ties running perpendicular to the rails. In general, this infrastructure has a useful life of 25 years.

Grade crossings, where automobile roads and pedestrian walkways intersect rail lines at the same level, have special maintenance and replacement needs, and are typically replaced as part of a stand-alone program.

The current program invests $109.5 million towards Track/R.O.W, which represents 4.1% of the total capital program. The majority of capital funds are directed towards systematic maintenance of subway rights-of-way, while a smaller portion is allocated to replacement of rails and ties on the commuter rail system.
The MBTA subway system operates on 185 miles of track with a wide variety of construction types, rail ties, and overhead catenary systems. The track network includes 125 miles of revenue track and an additional 60 miles of non-revenue track within rail yards and other service areas. The right-of-way (ROW) for heavy rail subway track often includes a highly electrified third rail running along the tracks through which subway cars receive traction power to move. These third rails have special maintenance needs, and are included in the Subway Signals program of this document.

The Red Line operates over 45 miles of revenue track. Types of track construction vary from standard wood tie track to concrete floating slab, with variations of the two. The line includes timber tie track, concrete dual block tie track, direct fixation, and concrete floating slab track. The entire line is powered by third rail. The Green Line (Light Rail) has a total of 46 revenue track miles. Although the track type varies throughout the Green Line, the majority of the line is a wood tie and ballast unit with some monoblock concrete tie track as well. The running rail on the line consists of both "T" rail and girder rail. The entire line is powered by overhead catenary. The Orange Line operates over 22 miles of revenue track. The type of track construction varies. The track consists of timber tie track, direct fixation, and concrete floating slab track. The entire line is powered by third rail. The Blue Line operates over 12 miles of revenue track. The type of track construction is primarily timber tie; however, sections of the track are monoblock concrete tie track. Throughout the Blue Line a combination of overhead catenary lines and third rail power the line.

Subway grade crossings have a useful life ranging from 12 to 15 years. Since portions of the Green Line are at street level and cross automobile traffic, there are 64 grade crossings along the Green Line and other crossings within MBTA maintenance facilities. The subway fleets operate over 1 million feet of mainline-ballasted track and over 400,000 feet of yard-ballasted track. The MBTA has approximately 560 mainline turnouts (sections of track which "turn out" from the main line), which have useful lives ranging from 4 to 25 years. There are 675 total yard turnouts and equipment, which have useful lives ranging from 8 to 25 years.

The majority of the funding is programmed for systemwide work throughout the rapid transit system.

<table>
<thead>
<tr>
<th>MBTA Subway Track &amp; Right-of-Way</th>
</tr>
</thead>
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<td><strong>Line</strong></td>
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</table>
FUNDED PROJECTS

Currently, funding is available for three projects in this capital program for the Subway Track/ROW program. These projects will have positive impacts on the operating budget; however, failure to complete these projects will have a negative impact on the Authority’s operating budget.

☑ Highland Branch (D-Line) Track Upgrade
This effort will fund the replacement of ties, ballast, and, in some areas, a full-depth reconstruction of the right-of-way along the Highland Branch. This five-year program will replace 50,000 ties and is necessary to upgrade this branch to top service grade condition.

☑ Green Line Grade Crossing and Track Reconstruction
The project is rebuilding 7 Green Line grade crossings and track on the B-Line: 2 on Beacon Street and 5 on Commonwealth Avenue. This will provide improved performance and more reliable service. Currently, 5 of the 7 crossings are complete, and the remaining 2 are scheduled for work.

☑ E Line Track Replacement
This project will fund track replacement between Brigham Circle and South Huntington Avenue to allow for revenue operation of No. 8 Cars

☑ Switch Replacement
The project will fund replacement of mechanical switches for the subway system.

☑ Systemwide Track Maintenance Program
This project represents funding that has been set aside to address on-going subway track infrastructure needs.

### Subway Track/ROW Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
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ANTICIPATED FUTURE NEEDS

Most of the rapid transit and light rail lines face maintenance issues, and the Systemwide Track Maintenance project above may encompass future upgrade and repair projects. Performing periodic renewal and replacement efforts in a timely manner reduces daily operating costs and life cycle costs, and increases reliability and safety. A continual rail-changing and tie-renewal program is needed to keep the track structure in a state of good repair. The following projects have been identified as future track needs.

☐ Track Design Standards
This project would develop track design standards and specifications.

☐ Green Line Grade Crossing Reconstruction
There are 37 Green Line grade crossings that are expected to need reconstruction and rehabilitation work in the coming years.
- **Green Line Tie Renewal Program**
  A tie renewal program to install new wood ties is anticipated along the B and C Lines.

- **Red Line Surface Tamper/Mainline Thermit Weld/Continuously-Welded Rail**
  The project involves the surfacing and tamping of track, and the thermit welding of the rail to improve the quality of service on the Red Line.

- **Red Line Floating Slab Alignment Repair**
  This effort would rebuild sections of the floating slab track between Harvard and Alewife.

- **Red Line Ashmont Line Rail Program**
  A program to replace the existing 150-pound type third rail with new 85-pound type third rail is anticipated for the Ashmont line. This project would combine lighter type third rail and improved electrical technology to deliver third rail power and to improve traction on this section of track.

- **Red Line Clayton Street Curve Reconstruction**
  This project involves the reconstruction of this section of track, and will allow the elimination of several speed restrictions.

- **Red Line Fully Guarded Switches**
  This project involves the deactivation of switches that do not meet track standards.

- **Orange Line Third Rail Upgrade**
  This program would replace concrete support pedestals that support the third rail on the Orange Line with 4,000 new blocks of treated wood. A program to replace approximately 2,000 feet of third rail in station areas is also anticipated.

- **Orange Line Special Track Work: Rebuild Wellington**
  Programs to rebuild track structures and replace yard turnouts in Wellington Yard are anticipated.

- **Blue Line Special Trackwork**
  This is a special trackwork renewal program to replace turnouts.

- **Blue Line Orient Heights Track Rebuild**
  The project involves the rebuilding of the track in the Orient Heights Facility.

- **Blue Line Rail & Tie Changing**
  A rail changing program is anticipated to replace worn rail, bolted rail, and ties from Bowdoin to Orient Heights stations.

- **Systemwide Track Charts**
  This effort would create track charts for the remaining lines to allow the MBTA to use systemwide track charts.
COMMUTER RAIL TRACK/RIGHT-OF-WAY

Commuter rail rights-of-way consist of rail, wooden crossties, grade crossings, and fencing. The commuter rail system operates on a vast network of over 600 miles of track, 1.5 million timber ties, and 257 grade crossings stretching across eastern Massachusetts.

Rail on the commuter rail system can be expected to last approximately 40 years, although curved rail has a shorter life span due to increased friction from vehicles. The MBTA commuter rail system includes over 1,300 miles of metal rail.

Approximately 1.5 million timber crossties and switch timbers support the track network. Railroad crossties are renewed on a cyclical schedule that prevents failed ties from imposing speed restrictions and delaying trains. Railroad crossties usually have a life span of 25 to 30 years depending on a variety of mechanical and environmental factors. These crossties also require a renewal of approximately 48,000 crossties and 5,000 switch timbers annually.

Grade crossings are the most prominent fixtures of the commuter rail system. The Authority has 257 grade crossings on the commuter rail system, requiring a replacement program averaging 21 crossings per year. The crossings ensure safety for both commuter rail passengers and highway motorists where roads and railroad tracks intersect. Grade crossings have a life expectancy of 12 years. The automatic protection equipment is maintained under the signal program.

A significant amount of commuter rail track maintenance is performed under the MBTA’s commuter rail management contract and is primarily funded through the operating budget.

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<thead>
<tr>
<th>MBTA Commuter Rail Track</th>
<th>Length</th>
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<td>Middleborough/Lakeville</td>
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<tr>
<td><strong>Total</strong></td>
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</table>
FUNDED PROJECT

The commuter rail track project listed below will have a neutral impact on the operating budget.

☑ Haverhill Double Tracking
This project will study the possibility of double tracking segments of the Haverhill Line.

Commuter Rail Track/ROW Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj Spending thru</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
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ANTICIPATED FUTURE NEEDS

The condition of commuter rail tracks throughout the system varies. Four lines are in fair to acceptable condition, four are in good condition, and three are new and in excellent condition. Systemwide, there are maintenance issues that apply to several or all of the rail lines. Performing periodic renewal and replacement programs in a timely manner reduces daily operating costs, reduces life cycle costs, and increases reliability and safety. The MBTA has identified the following projects as future needs for commuter rail track.

☐ Lowell Junction/Frey Double Track
This project would add double track to the Haverhill Line between Lowell Junction and Frey to reduce delays and improve the flexibility of scheduling both passenger and freight trains.

☐ Winchester-Mishawum Rail Replacement
This effort would replace 5.6 miles of 112-pound and 115-pound type rail on track between Winchester and Mishawum, a track segment used by both the Lowell and Haverhill Lines.

☐ Fitchburg Main Line Rail Replacement
This project would involve the replacement of 18.4 miles of 112-pound type, non-control-cooled rail on the Fitchburg Main Line between Willows and Fitchburg.

☐ Rail Inventory Purchase
This project would include the purchase of additional head-hardened 132-pound rail to replenish inventory and replace worn railing.

☐ Elimination of Bleachery Interlocking
This project encompasses numerous tasks: the relocation of Guilford’s train operations from Lowell to Lawrence, the removal of crossovers between the MBTA’s New Hampshire Main Line operations and Guilford’s Lowell Branch, the relocation of one crossover, and the removal of four other crossovers. By moving a large amount of track and signaling equipment beyond the Lowell commuter rail station, redundancies would be eliminated and the rail line would be improved.

☐ South Acton Station Double Track
This project would extend the double tracked portion of the Fitchburg Line west through the station at South Acton. The extension of the double track would allow trains turning at South Acton to be held clear of passing trains, and subsequently reduce delays.
□ **Reading Station Double Track**
This project would extend the Haverhill Line double track north through Reading Station. The extension would allow trains turning at Reading to be held clear of passing trains, thus reducing delays and freight conflicts.

□ **Beverly Drawbridge: Upgrade Mechanical Devices**
This project involves removing and replacing all outdated and worn gears and parts, redesigning the push/pull rod system and wedge mechanisms for greater reliability and durability, and updating bearings and ancillary equipment.

□ **Station Upgrade Approach**
This project involves the installation of approach tie pads at the expansion joints at several drawbridges.

□ **Systemwide Commuter Rail Fencing**
The installation and maintenance of fencing along the rights-of-way is important to safely operate trains, protect railroad property, and to prevent trespassing and illegal dumping of trash and contaminated materials on railroad property.

□ **Montvale Yard Rehabilitation**
This project would provide for the rehabilitation of the entire Montvale facility on the Lowell Line.

□ **Future Systemwide Tie Replacement/Renewal Program**
A systemwide replacement and renewal program for defective ties will enable continued reliable commuter rail usage.

□ **Systemwide Grade Crossing Renewal**
This project would provide funds for the renewal of grade crossings on the commuter rail system.
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## SIGNALS

### PROGRAM OVERVIEW

Train control is critical to providing service in a complex rail system. The signal system’s primary responsibility to control trains for efficient spacing and runtimes makes it an integral part of a transit system. The signal system’s goal is maintaining train separation while attempting to minimize headways and runtimes. To maintain proper train separation principles for route integrity, speed control and broken rail protection are employed in the design. These signal system aspects are thoroughly tested as part of the installation process and require ongoing maintenance. The MBTA employs two basic types of signal design philosophies: Absolute Block Signaling (ABS), as
installed on the Blue and Green lines, and Automatic Train Control (ATC), as installed on the Red and Orange Lines. The ABS system uses alternating current (AC) circuits. On the Blue Line, train separation is maintained by the use of trip stops while on the Green Line, the operator has sole responsibility for adhering to signal aspects. The ATC system, in use on the Red and Orange Lines, uses audio frequency track circuits. This allows the transmission of the maximum allowed speed to a semi-intelligent carborne subsystem. Maximum allowed speed is determined by civil restrictions as well as track conditions and is enforced by the wayside signal system in conjunction with the carborne subsystem.

With regard to implementation, signal systems use vital relays and processors that operate in a “fail-safe” mode. Non-vital systems act as an interface between the dispatcher and the vital systems. This equipment is housed in Central Instrument Rooms/Houses (CIR/H) and wayside cases or bungalows. This equipment, in turn, controls wayside equipment such as train approach lights, signals, switches, trip stops, and heaters.

This significant piece of MBTA infrastructure is absolutely crucial in supporting the safe and efficient operation of trains systemwide. The following section details some of these components and equipment.

**Signal Systems Components (Shared by Commuter Rail and Subway)**

**Switches, Crossovers, and Switch Heaters**

Switches and crossovers are incorporated in the track system to reroute trains. Both electric and hand throw switches are used. Switches that are used infrequently normally have a useful life of around 25 years. However, high-use switches that are thrown many times in daily operations have a useful life of 10 to 15 years. Switch heaters, which prevent freezing and keep switches functioning during the winter months, have a useful life ranging from one to five years, depending on location and frequency of use.

**Signals/Wayside Lights**

Wayside lights display a combination of signal aspects to communicate the status of the next track segment to the train operator. Signal housings have a useful life of approximately 20 years, while the bulbs inside last for only a few years. Future use of LED lamps will increase this life expectancy by up to 10 years, and will lower maintenance costs.

**Track Circuits**

The track circuit is the most vital part of the signal system and consists of a power source, a transformer or transmitter circuit, and a receiver or relay end. AC track circuits are used on the Blue and Green Lines as well as on all interlocking areas. Audio frequency track circuits, composed of a transmitter and receiver end, are used on the Red and Orange Lines. With intensive monthly maintenance, track circuits are expected to have a 20-year useful life.

**Grade Crossing Signals**

Grade crossing signals are used on the commuter rail network to warn automobile and pedestrian traffic of oncoming trains in locations where roads and highways cross railroad rights-of-way. The capital equipment at these intersections has a useful life of 20 years.
Signal System Components (Subway Only)

Train Stops and Train Stop Heaters

Train stops are utilized on the rapid transit lines to ensure compliance with restrictive conditions and have a useful life of 20 years. Train stop heaters allow the train stops to function normally in winter weather conditions and have a useful life of up to 5 years.

Third Rail Heaters

Third rail heaters are used to prevent the third rails from icing during winter months. The Authority utilizes over 540,000 feet of third rail heaters. All third rail heaters have a useful life of 2 to 5 years. In addition, there are 43,990 third rail heater insulators, which typically have a useful life of 5 years.

Train Approach Lights

Train Approach Lights are deployed on the rapid transit lines as a safety indicator for operations personnel on the right-of-way. With thorough maintenance, these lights can be expected to have a useful life of 20 years.

The current program invests $183.8 million for signals. The signal program represents 6.8% of the total capital program. Major signal efforts include the replacement of the northern segment of the Orange Line signal system, and an upgrade to the Blue Line signal system.
SUBWAY SIGNALS

The Authority’s subway signal program consists of two types of control systems on the various lines, ATC and ABS. The Red and Orange Lines use an Automatic Train Control (ATC) system while the Blue and Green Lines utilize an Absolute Block Signal (ABS) type system. Each line consists of mainline and yards segments.

- The Red Line signal system consists of several yards and mainline segments. It is an ATC system, using vehicle systems and wayside controls to regulate train movement. There are a total of 135 switches, 210 signals, 16 instrument houses, 355 track circuits, 1,632 third rail heaters, 68 switch heaters, 2 train stop heaters, 2 train stops, 12 train approach lights, and 16 instrument houses. A large portion of the Red Line is above ground and exposed to the elements; therefore, a significant number of third rail heaters are needed on this line.

- The Green Line signal system is equipped with the ABS signal system, however, it does not utilize train stops. A total of 91 switches, 497 signals, 497 track circuits, and 40 switch heaters operate on the Green Line. Portions have been upgraded following the flood of 1996, including the segments from Brookline Village to Hynes Auditorium. The equipment between Haymarket and North Station has just been upgraded as part of the North Station Superstation project in the System Enhancement section of this document. Science Park to Lechmere signals work is underway and near completion.

- The Orange Line utilizes a combination of ATC and wayside block signal systems. This line has a total of 107 switches, 199 wayside signals, 245 track circuits, 457 third rail heaters, 101 switch heaters, 34 train stop heaters, 17 train stops, 48 train approach lights, and 12 instrument houses. The signal system to the north from Chinatown to Oak Grove is about 25 years of age and is currently being replaced.

- The Blue Line has a total of 86 switches, 154 signals, 181 track circuits, 12 third rail heaters, 43 switch heaters, 145 trip stops each with two heaters, 74 train approach lights, and 8 instrument houses. The Blue Line is equipped with ABS and train stops and does not utilize on-board subsystems for train movement. Wonderland and Orient Heights along with the Main Line are being reconfigured to fit 6 car trains.

The signal equipment that interfaces with the Operations Control Center (OCC), bungalows/central instrument locations, wayside systems, and yard systems, are universal along the subway system. Each has a useful life of 25 years, with the exception of the OCC. The useful life of the OCC is based on availability of spare parts for computers, which have a life cycle of 5 years (for more information on the OCC, see the Communications section of this document).

FUNDED PROJECTS

Currently, there are six funded subway signal projects underway. The upgrade of the Orange Line signal system is the most significant effort underway in the subway signal program. Other major projects include the upgrade of the Blue Line signal system (an element of the Blue Line modernization effort) and a systemwide signal infrastructure reinvestment effort. All signal projects listed below will have a positive impact on the Authority’s operating budget by reducing the signal components’ mean time between functional failure. With newer systems, equipment, and redundancy, the mean time to repair a failure will be substantially reduced. By keeping the number of failures and time needed for repairs low, overtime by operations personnel to facilitate revenue service will be minimized. These benefits are somewhat offset...
by deferred replacements on the oldest portions of the signal systems, with the potential for outages increasing over time.

☑ Systemwide Signal Maintenance Program
This project represents funding that has been set aside to address subway signal infrastructure needs. The project will maintain and replace third rail heaters, signal lights, track circuitry, and cable plant across the subway system.

☑ Red Line Signal/Cable Upgrades
The purpose of this project is to replace existing Generation One Track Modules and associated hardware and wiring on the Authority’s Red Line. Generation Five Track Modules are presently being installed on the Red Line at 6 locations. This effort will result in more reliable and efficient service.

☑ Green Line Lechmere Station Signalization
This effort will provide signalization at the proposed Lechmere Station.

☑ Columbia Junction
This project will fund all switches, cables and track modules, which will increase service reliability at this critical junction on the Red Line.

☑ Orange Line North Signal System Upgrade
This purpose of this project is to design and install a state-of-the-art Automated Train Operating (ATO) system on the Orange Line from Chinatown to Oak Grove with interfaces at Wellington Yard and Chinatown. The new ATO system would be compatible with the existing ATO system on the Southwest Corridor and the Orange Line fleet’s ASC. Also, a new communications link to the OCC will be constructed. This project is currently under full construction, and should last three years. Service diversions are in place on some weeknights to allow this project to be completed.

☑ Blue Line Signal Upgrade
The scope of this work will involve the study and upgrade of the signal system along the Blue Line to accommodate six-car train service. The signal upgrade will be performed in conjunction with the Blue Line Modernization effort.

Subway Signals Projects ($ in millions)

<table>
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<th>PROJECT</th>
<th>Authorized Budget</th>
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<th>FY08</th>
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ANTICIPATED FUTURE NEEDS

Regular maintenance for all signaling components is needed to maintain safety and reduce operational breakdowns. New signaling technology should also be considered to improve safety and operations, as well as to decrease maintenance costs. The following projects have been identified as future efforts for subway signal needs.

☑ Red Line JFK/UMass/North Quincy
This project would consolidate the cable plant and signal houses at the JFK/UMass and North Quincy stations.
Red Line Signaling Standardization
Long-term issues include signaling standardization using Generation Five Track Modules.

Evaluation of Future Technology Study
The Signal Division is considering the use of Communication-Based Train Control (CBTC) for both the Green and Blue Lines.

Green Line Systemwide Signal Improvements
The overall condition of signal equipment including interlocking logic, track circuits signaling and switch heater controls must will be addressed incrementally. Technology updates are needed, including replacement of most systems with technology updates, interlocking logic, track circuits signaling and switch heater controls. Specific technologies to be used would be identified through the Evaluation of Future Technology Study mentioned above.

Highland Branch Wayside Signal Replacement
The project involves the replacement of signals on the Highland branch and would include the Reservoir Yard. The technology would be identified through the Evaluation of Future Technology Study mentioned above.

Third Rail Heater Central Control
This project involves the design and implementation of a systemwide third rail heater control system to provide automated on/off regulation from the Operations Control Center.
COMMUTER RAIL SIGNALS

The Authority’s commuter rail signal system consists of over 480 miles of signalized track, 190 miles of aerial pole line, 80 interlockings, 10 train control machines, over 1,000 signal heads, 476 electric switches, and 200 grade crossings with automatic protection equipment. There are 35 bungalows and 52 bungalow/houses in the commuter rail signal system. These systems have a useful life of 25 years. Two system-wide signal units are the wayside system, and the OCC signal equipment. Both systems have a 25-year useful life.

Annual replacement of underground signal cable, aerial signal cable, electric switch machines and electric grade crossing mechanisms is required to assure a safe, reliable signal system with an efficient life cycle cost.

Signal maintenance is performed under the commuter rail management contract and is primarily funded by the operating budget.

FUNDED PROJECTS

There are two projects for the commuter rail signal program, both of which will have a neutral impact on the operating budget.

- **Fitchburg Line Signal Upgrade**
  This project will replace the existing open-wire, telephone-based relay system on the Fitchburg commuter rail line from Willows to Fitchburg with a modern microprocessor-based code system. This project will eliminate many of the signal-related delays on this line.

- **Haverhill Line Signal and Interlockings Improvements**
  This project will fund track and signal modifications associated with the second phase of construction of the Lawrence Intermodal Station (see the System Enhancements section of this document) as part of an interagency agreement. Scope will include a new interlocking and dispatching mechanism to permit more operational flexibility around the station. This project will move forward contingent upon the MBTA receiving capital funds generated by other rail service providers.

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
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ANTICIPATED FUTURE NEEDS

The future commuter rail signal program will focus on the replacement of outdated technologies with newer equipment that enhances flexibility. Older code systems (which provide signal control from remote locations) are currently in use, as are older coded track circuits that require high maintenance. Open wire pole lines are susceptible to wind and ice damage, creating maintenance and safety concerns. The following projects have been identified as future needs for the commuter rail signal system.
☐ **Haverhill Line West Route: Signal Improvements**  
The scope of this project is to enhance train throughput on the West Route Main Line. Other tasks include the design and installation of a power switch at Ash Street in Reading and the redesign of Wilmington Junction Interlocking as a universal crossover between the Wildcat branch and the Haverhill Line tracks.

☐ **West Street Bridge Cable Replacement**  
This project involves the replacement of cable along the West Street Bridge.

☐ **Fitchburg Line Waltham Tower Elimination**  
The purpose of this work is to eliminate the Waltham Tower by replacing field code units with units compatible with the new Computer Dispatch Center.

☐ **Haverhill Line Andover/Rosemont Signal Upgrade**  
The project involves upgrading the signal system to a modern bi-directional Centralized Traffic Control System (TCS) on the Haverhill Line from Andover Street to Rosemont.

☐ **Gloucester Branch Signal Upgrade**  
The purpose of this project is to improve the reliability of the Gloucester branch signal system through a series of tasks: replacement of the track code system, installation of a power switch, elimination of the pole line, and upgrading the crossing warning systems.

☐ **Newburyport Line Signal Upgrade**  
This project provides signal upgrades from Beverly Junction to Chelsea.

☐ **Lowell Line Wilmington and Shop Interlocking/Bi-directional Signals**  
The scope of this project is to complete the Traffic Control System (TCS) signal system upgrade on the Lowell Main Line between Wilmington Interlocking and Shop Interlocking.

☐ **Lowell Line Somerville/Winchester Bi-directional Signals**  
The purpose of this project is to complete a Traffic Control System (TCS) signal system upgrade on the Lowell Line between Somerville Junction and Winchester.

☐ **South Bay Track & Signal—Phase II**  
The first phase of this effort was completed in the 1990s. Remaining scope includes the design and installation of three additional signal interlockings and minor track work leading into the Storage & Inspection facility in South Boston. This work will support additional system expansion on the southside.

☐ **Worcester Signaling Improvements**  
The project will fund improvements to the signal system along the Framingham/Worcester Rail Corridor.

☐ **Fitchburg Signal Work**  
The project will fund major improvements to the signal system on the Fitchburg/South Acton Line.
COMMUNICATIONS

PROGRAM OVERVIEW

The MBTA Communications Department is responsible for a variety of low voltage systems. These responsibilities include maintaining an extensive inventory of equipment and overseeing contract services for the Wide Area Network, two-way radio systems, microwave links, emergency intercoms, public address systems, Light Emitting Diode (LED) message signs, fire alarm systems, security systems, and the Supervisory Control and Data Acquisition (SCADA II) system. These systems have been developed over time and vary significantly in age and condition. The MBTA communications system also includes the Operations Control Center (OCC).
The Operations Control Center (OCC)
The OCC is one of the most automated transit control centers in the world. The OCC consists of proven state-of-the-art computer-based technology that allows real-time monitoring and supervisory control of the signal and communication systems for all four transit lines. The Bus Radio System Network is also integrated into the OCC communication system. The OCC has a useful life of 25 years.

Telephone Equipment and Services
These assets have an average useful life of 4 years and include:
- Electronic key and analog telephones and ISDN equipment;
- PENTA voice communications switch (controlling audio services for the subway and bus dispatch);
- A wayside/emergency phone network (pump rooms, emergency exits, vent shafts, bungalows, etc.);
- A voice messaging system;
- A network of special services for communications applications;
- A network of copper and fiber optic cables; and
- Over 4,500 voice and data leased circuits.

SCADA II
The SCADA II system monitors and controls equipment (emergency ventilation fans, fire alarms, generators, pump rooms, etc.) at remote locations. The system is composed of two subsystems. The first system is based on original remote monitoring and control units installed in the 1980s and has exceeded its life expectancy, while the second is a programmable logic controller (PLC) based system controlling over half of the MBTA’s emergency vent fans. The PLC system has a useful life of 10 to 20 years, and includes:
- A main and a standby central processor;
- Remote Control and Monitoring Units;
- Programmable Logic Controllers (PLCs);
- Various routers, modems, switches, and hubs; and
- Remote control terminal cabinets

The replacement project for the remaining remote monitoring and control units is in progress.

Systemwide Radio
The current two-way radio system is an analog system. This system is currently programmed for replacement with a new digital system. All such radios have a useful life of 7 years, with the exception of base stations and support equipment, which have a useful life of 25 years. The current system components include:
- Revenue vehicle radios (bus, rapid transit, and light rail);
- Non-revenue vehicle radios, including those on Police vehicles
• Portable radios;
• Base stations, antenna network, and support equipment; and
• Audio Recorders

A replacement project for the systemwide radio is in progress. This new system shall incorporate a digital trunking radio system that will replace the existing stationary, mobile, and portable radio equipment. The new radio system will incorporate computer aided dispatch (CAD) and automated vehicle location (AVL) systems for Bus Operations.

**Wide Area Network**

The Wide Area Network (WAN) provides a network of interconnected fiber optic and copper cables that is the communications medium between electronic devices throughout the MBTA’s service district. The WAN also provides the hardware, known as edge equipment, to interface individual electronic devices into the network. Typical components include:

- Synchronous Optical Network (SONET) based transmission equipment;
- Global Positioning System (GPS) based timing system;
- Pulse Coded Modulation (PCM) channel banks; and
- Network Management Software

Through ongoing efforts, the Telecommunications Division is expanding the WAN to all facilities within the Authority.

**Public Address**

The public address system is comprised of two major components. First is the Voice Storage Unit (VSU) located at the Operations Control Center. The VSU provides the user interface between the personnel located at the OCC and the station public address systems. The VSU was installed in the late 1980s and has reached its life expectancy. MBTA Contract No. 65-04 provides for the design, procurement, installation, integration, testing, and maintenance of a fully functional Public Address / Electronic Sign System Head End that will replace the VSU. This contract will also include the replacement of all the electronic signs at three (3) rapid transit stations (Downtown Crossing, Back Bay, and Porter Square) and the up-grade of all the electronic signs at three (3) rapid transit stations (North Station, Airport, and Aquarium) to function with the new Head End.

This contract will provide an integrated Public Address / Electronic Sign System Head End that will 1) provide a new workstation for the recording and transmitting of public address announcements; 2) interface with the Operations Control Center dispatch consoles allowing each dispatcher to perform public address announcements; 3) interface to the train tracking system that will provide automated train location and route announcements; and 4) provide the basis of a announcement system to transmit American with Disability Act (ADA) compliant audio and visual messages to passenger stations.

The second component is the field public address systems. Each station has its own public address system that is comprised of power supplies, amplifiers, mixers, graphic equalizers, local microphones, and loud speakers. In an effort to enhance the intelligibility of public address announcements the Telecommunication Division shall perform speech intelligibility tests at each station. With this information, acoustical studies can be performed and a program can be implemented (as funding becomes available) to upgrade station public address systems. In addition to upgrading the audio portion of the public address system, electronic (LED) message signs would be installed to provide visual messaging.
Funded Projects

Currently, there are 6 funded communications projects underway. Most projects involve upgrading the Authority’s radio communication with new state-of-the-art digital technology. The systemwide radio project will generate savings for the Authority’s operating budget, while the remaining projects will have a neutral impact on the operating budget.

- **Systemwide Radio Communications Project**
  This major project seeks to expand and overhaul the entire existing radio system and to replace the tunnel antenna system. The project will deploy an upgraded digital system, taking advantage of 20 channels licensed by the Federal Communications Commission.

- **Bus OCC Installation**
  This effort will consist of the construction of a new Bus Operations Control Center including voice and data wiring, consoles, computers, Automatic Vehicle Locator equipment and programming associated with the operations of a Bus OCC. This project is substantially complete and is operational with many new bus fleets, and this represents mostly closeout costs.

- **SCADA II/C-Cubed Police Talkback Box Replacement**
  This project involves the purchase and installation of assistance telephones and ancillary equipment at existing police talkback locations. This equipment will fully comply with the Americans with Disabilities Act.

- **Station Management Portable Radios**
  This project procures 300 new digital portable radios that will be required for the Customer Service Agents in the near future as part of the Station Management Project.

- **Customer Care Center**
  This project will fund the procurement of equipment inclusive of software, to create a call center, which is intended to act as central point of contact for the Authority’s customers.

- **Customer Service Phone Installation**
  This effort funds the installation of an upgraded customer service phone system to handle the 1.6 million phone calls the Authority receives annually. It will also reduce the cost of developing passenger, vehicle and employee schedules and provide for a greater flow of accurate information including enhanced service for hearing impaired customers.

### Communications Projects ($ in millions)

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Page 56: MBTA CAPITAL INVESTMENT PROGRAM FY07-FY11
ANTICIPATED FUTURE NEEDS

To improve safety and operations throughout the system, several communication upgrades are anticipated, including new Public Address (PA) equipment and new mobile radios. Without system upgrades, the communications program would experience continued operational and maintenance inefficiencies, which could increase future maintenance costs.

- **Field Radio Procurement**
  This project would purchase portable radios to ensure personnel safety along the MBTA right-of-way.

- **Active Train Summary System – Commuter Rail OCC (CROCC) Enhancement**
  This project would extend the Real Time Active Train Summary at the current CROCC to include trains on line segments dispatched by Guilford and Amtrak, allowing one system to encompass virtually the entire commuter rail system, and minimize signaling and scheduling conflicts between MBTA commuter rail trains and freight trains.

- **SCADA II/C-Cubed Police Talkback Box Replacement**
  This project would involve the purchase and installation of ADA-compliant assistance telephones and ancillary equipment at existing police talkback locations.

- **Installation of Systemwide Emergency Wayside Telephones**
  This project would replace existing wayside emergency telephones at locations along the Orange, Red and Green Lines.

- **Communication Rooms Refurbishment**
  This project would rehabilitate or replace power, lighting, HVAC units and structural problems at various communication rooms throughout the subway system.

- **Fiber Optic Cable Network**
  This project would involve the installation of single mode fiber optic cable along the Red and Green Lines.

- **Remote Control and Monitoring Units (RCMU) Replacement**
  This effort would replace the remaining antiquated emergency vent fan remote control and monitoring units (RCMU) with programmable logic controllers (PLC).
POWER

PROGRAM OVERVIEW

The MBTA’s power program maintains one of the most complex, important, far-reaching, and expensive systems in the transportation network. Using power supplied by an outside utility, the MBTA transforms and distributes electricity over its own system to power the entire network of subway, trackless trolley, and light rail lines. This large and complex power system, complete with its own backup generation capabilities in a full-scale switching station in South Boston, includes millions of feet of cables, many substations, circuit breakers, switch boxes, switch heaters, manholes, ductiles (as well as storage facilities for cable and power equipment), switchboards, and circuit breakers. The power program also includes the catenary systems for the Green and Blue lines, and the trackless trolley system.

The power program is also responsible for lighting at the ferry facilities located at Lovejoy Wharf, Hingham Shipyard, World Trade Center, Long Wharf, and the Charlestown Navy Yard. The commuter rail electrical network provides lighting and power for signal systems, communication systems, lift bridges, buildings, stations, parking lots, maintenance facilities, layover facilities, and grade crossings.

The capital equipment in this power program is absolutely essential to operations: it supplies to subway trains and trolleys the traction power they need to move, to the signal systems the power needed to control the trains, and to the passengers and stations the power needed
to turn on the lights and operate the elevators and escalators. The MBTA’s power program, arguably one of the least visible elements to passengers, is one of the most complex, important, far-reaching, and expensive systems for the MBTA to maintain. The current program invests $74.8 million toward power. The power program represents 2.8% of the total Capital Investment Program.

**SUBWAY POWER**

Subway power covers all aspects of the Authority’s rapid transit and light rail power needs.

**Power Substations**
The subway power division maintains substation equipment to convert 13.8kV AC transmission level power down to 600 volt DC distribution level power to feed third rail subway loads and 480-volt AC distribution power for passenger stations, vent shafts, and signal bungalows. This equipment is expected to last 30 years. In addition, the Green Line has track switch equipment, which has a useful life of 15 years.

**Unit Substations**
Details on unit substations vary widely depending on location and context, but all include systems necessary for transportation, specifically the signal feeds, and other systems that protect both customers and transit infrastructure alike. There are 50 unit substations along the subway/transitway system: 16 on the Red Line, 10 on the Green Line, 18 on the Orange Line, and 4 on the Blue Line. There are two unit substations on the Transitway. All substations are required to be within close proximity of the equipment they power and are exposed to severe environmental conditions. Components of substations include load break switches, 115kV oil circuit breakers (OCB), vacuum breaker conversion units, transformers, and distribution equipment. The useful life of a unit substation is 20 years.

**Traction Power Substations**
There are a total of 48 traction power substations throughout the subway system: 25 on the Red Line, 9 on the Green Line, 7 on the Orange Line, and 7 on the Blue Line. Traction power stations have a useful life of 20 years.

**Cable**
The MBTA has over 3 million feet of AC cable distributed along the four subway lines. All AC cable has a useful life of 40 years, except along the Green Line, where the useful life is 15 years. The Orange Line has over 600,000 feet of DC feeder cable, which has a useful life of 20 years. Also, there are 18 SWC MODs and cable on the Orange Line and these cables have a useful life of 15 years. The Green Line has about 750,000 feet of DC feeder cable. The useful life of the DC cable is 30 years.

**Overhead Contact Systems (OCS)**
Overhead Contact Systems (OCS) are located along the Green and Blue Lines, and on the Mattapan Highspeed Line. These systems have a useful life of 20 years, and some work along the Mattapan Line is currently underway.

**Passenger Station Low Voltage Switchgears**
There are 54 passenger station low voltage switchgears along the rapid transit and light rail systems. Low voltage switchgears feed power to the subway signal system, pump rooms, car houses, escalators, elevators and other various areas of the Authority where power is required. These systems offer protection for customers, Authority equipment, and the system overall. Along the Red and Orange Lines, these systems also feed fire alarm systems, Amtrak
and subway signal systems, ventilation, elevators, escalators and a variety of other equipment. Passenger low voltage switchgears have useful lives ranging from 20 to 30 years.

FUNDED PROJECTS

The Authority has ten funded projects under the subway power program. These projects will have a neutral impact on the Authority’s operating costs.

☑ Red Line Substation Improvements: DC Breaker Upgrade
This project will replace two open-faced/elevated DC breakers on the Red Line. This will improve safety for MBTA personnel and service reliability for passengers.

☑ Green Line Power Study
The project will fund a study of power needs and capacity on the Green Line based on expansion of the fleet with the introduction of the No. 8 car.

☑ Green Line Highland Branch (D-Line) AC Cable Replacement
The project involves the replacement of deteriorated Aerial AC traction power cables with new state-of-the-art AC cables, with attachments to newly installed catenary beams.

☑ Blue Line Negative Returns
This project encompasses the replacement of negative return cables between Maverick Station and Orient Heights Station. This will increase reliability and reduce maintenance costs.

☑ Blue Line Modernization: Aquarium Traction Power (and Ventilation)
This project includes the construction of a traction power substation and vent shaft building at Chatham Row and State Street. Enabling six-car train service as part of the Blue Line Modernization project requires a new power source for the line at this location.

☑ Blue Line Overhead Catenary System Repairs
This project will replace the headspan support and feeder taps on the Blue Line’s overhead catenary system. This equipment has attained its useful life, and the replacement will ensure the continued safe and reliable operation of Blue Line service.

☑ Mattapan Line Catenary Improvements
This project will fully replace defective catenary lines and support poles on the Mattapan Highspeed Line. This will ensure future pantograph operation and future service reliability.

☑ Substation Control Batteries
This project will replace the batteries that power the control board at 41 traction power substations on all subway lines. The batteries are crucial to ensuring continuous delivery of power for service in the event of power reroutings, power section problems, or failures.

☑ Orange Line Power Improvements
This project will identify and fund power improvement projects and other infrastructure work, necessary for the operation of the next generation Orange Line vehicles.

☑ Rectifier Transformer Replacement
This project will include the removal and disposal of 10 critical transformers and installation of their replacements. This will increase the reliability of the power system and will lower maintenance costs for the Authority.
Subway Power Projects ($ in millions)

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**ANTICIPATED FUTURE NEEDS**

The power system regularly needs replacement of cables, circuit breakers, manholes, ductiles, and unit substations, as well as storage facilities for cable and power equipment. It is necessary to inspect and repair the exhaust stacks on the gas turbine generator engine (the MBTA's emergency generator) in South Boston, update the engine contacts with the latest technology and safety devices, conduct periodic maintenance on aging equipment, and refurbish old and overloaded substation buildings. The following projects have been identified as future needs for the subway power program.

- **Red Line Substation Improvements**
  This would continue refurbishing substation buildings and replace all of their internal operating equipment along the Red Line. It will also include upgrades along the Mattapan Line, as well as perform cable installation in various locations.

- **Red Line Northwest Extension Cable Upgrade**
  The project involves the replacement of 480 high-voltage AC cables with surface mounted systems at Harvard, Davis, and Alewife stations.

- **Red Line Cabot DC Breaker Replacement**
  This project involves the replacement of DC breakers at Cabot switch houses.

- **Red Line Traction Power Upgrade**
  This project involves the continuing rehabilitation of traction power stations along the Red Line.

- **Blue Line Power Upgrade**
  This project involves the replacement of the passenger station unit substations (one substation being done as part of Blue Line modifications).

- **Blue Line Yard Catenary**
  This project encompasses the complete replacement of the OCS system in the Orient Heights Yard, as well as other areas along the line.

- **Blue Line Power Supply (Wonderland)**
  This project involves the installation of two AC cables from Orient Heights substation to Wonderland substation. Also, all substation buildings would be refurbished and all the internal operating equipment replaced.

- **Orange Line Substation Improvements**
  This project would refurbish the substation buildings and replace all the internal operating equipment for substations at Wellington, Malden, and Oak Grove. Passenger
station upgrades are needed at Oak Grove, Malden, Wellington, Wellington Shop, Sullivan Square, Community College, and North Station.

- **Orange Line Cable Upgrade**
  This project would replace and remove from the manholes all manhole cable switches on the Southwest Corridor.

- **Orange Line Negative Return System Upgrade**
  This project involves the installation of negative return cables from substations to track along the Orange Line.

- **Orange Line Power Improvements**
  This project involves the installation of AC cable and DC breakers along the Orange Line.

- **Green Line Substation Improvements**
  This project would refurbish the substation buildings and replace all the internal operating equipment at Riverside, Reservoir, and internal operating equipment only at 45 High Street. A substation upgrade is anticipated at Riverside.

- **Green Line Catenary Replacement**
  This project would completely replace the overhead catenary system on Commonwealth Avenue, the Lake Street Yard near Boston College, Lechmere, the Reservoir Yard, and Huntington Avenue. The highest priority would be the Boston College B-Line of the Green Line.

- **Green Line Cable Upgrade**
  Two AC cables would be installed from Coolidge substation to Reservoir substation. Also, track switches, controls and heaters would be replaced along the Green Line, the DC cable feed from Oak Square to Watertown Square would be upgraded.

- **Green Line Vent Shaft Upgrade**
  The purpose of this project would be to upgrade all vent shaft AC cables to accommodate increased loading.

- **Green Line Government Center Substation Replacement**
  The project would replace the existing BECO equipment and substation that power tunnel ventilation fans, Blue and Green Line signals, the pump room and station lighting in the vicinity of Government Center station.

- **Orange Line/Green Line Negative Return Cable**
  The purpose of this effort would be to upgrade the DC negative return system on the Orange and Green Lines.

- **Green Line/Blue Line Section Insulator Replacement**
  This project would remove the existing heavy section insulators and replace them with new, lightweight, state-of-the-art design double-beam section insulators on the entire Green Line and in Orient Heights Yard.

- **Rectifier Transformer Replacement**
  This project would continue the removal and disposal of critical transformers and installation of their replacements along the system. The initial phases of this work is funded and work is underway.

- **Emergency Lighting Systems Replacement**
  The purpose of this project would be to replace all 125-volt DC emergency lighting systems at 10 stations on the Blue and Red Lines.
COMMUTER RAIL POWER

The commuter rail’s electrical system provides lighting and power for signal systems, communication systems, bridges, buildings, stations, parking lots, maintenance facilities, layover facilities, and grade crossings. This system also provides redundant power at critical facilities and cables to operate mechanical power on the Beverly Drawbridge.

Signal Systems
The commuter rail power programs are responsible for maintaining 366 switch heaters and 24 gas switch heaters. Both switch and gas switch heaters have 20-year useful lives.

Layover Facilities
Each layover facility control center, typically located at the end of commuter rail lines, has a 20-year useful life.

FUNDED PROJECTS

Currently, the Authority has not programmed capital projects for the commuter rail power program.

ANTICIPATED FUTURE NEEDS

Improvements and upgrades to the electrical system are anticipated to avoid train delays and service interruptions. All outdated equipment including navigation lights, direct buried cable, control components, circuits, and transformers will be replaced. All switches associated with the 4160-volt power distribution system will be disconnected. This corrective action would enhance system reliability and prevent power failures. Periodic inspections and maintenance would continue on all power equipment and electrical units. The following projects have been identified as future needs for commuter rail power.

- **Commuter Rail Systemwide Electrical Infrastructure Enhancements**
  This project involves the upgrade of electrical controls for the Beverly Drawbridge, passenger information signs, and electrical data from stations, parking lots and facilities.

- **Passenger Station Generator Purchase**
  This project involves the purchase of a 200kW generator that would allow emergency operation of passenger stations.

- **Switch Heater Replacement**
  This project involves the installation of 2 sets of switch heaters, including operation test locations for the switch heaters.

- **Newton Lighting Fixtures**
  This project entails the replacement of 60 pole-mounted lighting fixtures at three stations in Newton.

- **Emergency Lighting Tower Purchase**
  This project involves the purchase of 2 towable emergency lighting towers with generators.

- **Mystic Junction**
  This project consists of the installation of a transformer containment yard at Mystic Junction.
☐ **Fitchburg Commuter Rail Layover Facility Power**  
This project would entail the installation of a complete power system and new track layout at the Fitchburg layover facility.

☐ **Layover Unit Substations Fans & Vents Installation**  
This project would install ventilation fans at the Worcester, Kingston, Middleborough, and Newburyport layover facilities.
SYSTEMWIDE POWER

Systemwide power includes the main distribution system as well as the backup generators for all MBTA transit services. This section also covers the catenary system for the trackless trolley routes.

South Boston Power Complex Gas Turbines
The MBTA owns and maintains 2 emergency backup generators in South Boston. They exist primarily to provide power to the Authority’s power grid if the power from the outside utility 115kV lines is lost. The jet turbine units and switch stations were built in the 1980s and provide backup power to 80% of the MBTA’s transportation system. Each unit has a useful life of 25 years.

Supervisory Systems
The Power division maintains two supervisory control systems, which allow for continuous remote monitoring and control of all power facilities. The primary system, called SCADA (see more detailed description in the Communications section of this document), employs two central computers that constantly poll all traction substations and present the received information on four workstation consoles located at Power Control. The backup system, called “One on One,” employs a simplified system of point-to-point communication between microprocessors located at the Cabot Control Center and the field sites. The received data is mapped onto an array of lamps that are read by dispatch personnel. The system has a useful life of 25 years.

Substation Equipment
Traction power substation equipment is used to convert 13.8 kV AC transmission level power both to 600 volt DC distribution level power to feed third rail subway loads, and to 480 volt AC distribution power level for passenger stations, vent shafts, and signal bungalows. The equipment used in the process consists of 15 kV rated AC switchgear, rectifier transformers, DC rectifiers, 750 volt rated DC switchgear, unit power transformers, station batteries, and supervisory control units. Well-built and well-maintained substation equipment has a useful life of 25 to 30 years.

Unit Substations
There are 67 unit substations (USS) throughout the Authority. The substations are generally located in the subway station or facility it supports. Unit substations provide power to lights, vents, and fans. The USS loads vary widely and include systems necessary for transportation, specifically the signal feeds, and other systems that protect both the customers and the transportation system alike. Substations are required to be in close proximity of the equipment they power and as a result are exposed to adverse environmental elements. The useful life of a unit substation is 20 years.

FUNDED PROJECTS

There are two funded projects under systemwide power. These projects will have a positive impact on the operating budget.

☑ Trackless Trolley Catenary Improvements
This effort will replace all corroded and undersized poles, worn out switches, crossings, and wire throughout the trackless trolley network in Cambridge, Belmont, and Watertown. The upgraded catenary system will enhance the performance and reliability of both the existing trackless trolleys, as well as the programmed replacement fleet of new Electric Trolley Buses in the future.

☑ SCADA System Replacement
This effort will fund the replacement of the existing SCADA power system, which monitors the power system and remote control of electrical devices. The project will
involve design, equipment procurement and installation, integration and complete conversion from the current system to a new system.

**Systemwide Power Projects ($ in millions)**

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
<th>FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
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<th>BEYOND FY11</th>
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**ANTICIPATED FUTURE NEEDS**

The following future efforts have been identified as needs for the systemwide power program.

- **Systemwide Power Upgrades**
  The supervisory control systems controlling the power operation would be replaced, and an overhaul of the OCBs at the South Boston Switching Station is anticipated.

- **Power Vehicle Replacement Program**
  This program would replace the wire car currently used for all OCS maintenance.

- **Systemwide AC Cable Replacement Program**
  This project would rehabilitate AC unit substations and complete the vacuum conversion of the AC circuit breakers.

- **Charlestown Cable Storage Facility**
  This project would involve the conversion of an MBTA-owned property in Charlestown into a facility for cable storage.

- **Employee Facility Training Program**
  This would construct training facilities for power division employees.

- **Systemwide Power Cable Replacement Program**
  This would allow for the provision of storage facilities for cable and power equipment, help replace worn out cable handling vehicles and aging AC and DC cable lengths. Additional cables would be installed to accommodate increased system loading.

- **Systemwide Unit Substation Ventilation**
  A program to build substation ventilation equipment throughout the system is recommended.
MAINTENANCE FACILITIES

PROGRAM OVERVIEW

Maintenance facilities, or yards and shops, are the sites for regularly scheduled maintenance and emergency repairs on MBTA vehicle fleets. The Authority maintains 4 rapid transit yards and shops, 4 light rail, 3 commuter rail, and 9 bus facilities, including one bus repair shop. There are also 17 smaller general maintenance facilities throughout the system. A new facility was constructed to maintain Silver Line vehicles and new CNG buses. Each facility generally includes a basic building structure with a mechanical plant and shop equipment. The expected life cycle of each of these facilities is 50 years.

The arrival of large fleets of vehicles equipped with new technologies will place additional demands on the personnel and facilities that maintain, repair, refuel, and service the vehicles. New fueling equipment and engine equipment designed for CNG buses, and maintenance and support equipment for longer 60-foot buses will be needed. Low-floor technologies on the new Green Line subway cars and incoming bus fleets will have special new needs as well.

Maintenance Facilities Funding

- Other Capital Investments: $2,562.9m (94.9%)
- Bus: $105.7m (3.9%)
- Subway: $30.1m (1.1%)
- Commuter Rail: $2.7m (0.1%)
- Maintenance Facilities: $138.4m (5.1%)

Chapter 7
MAINTENANCE FACILITIES

Therefore, reflecting the higher infrastructure costs of owning CNG buses, the majority of the current $138.4 million program is devoted to constructing new or renovating existing facilities to serve CNG buses. The maintenance facilities program represents 5.1% of the total Capital Investment Program. The new Silver Line facility is programmed under the Silver Line in the System Expansion section of this document.

SUBWAY MAINTENANCE FACILITIES

Maintenance facilities for rapid transit and light rail fleets include:

- A Red Line facility at Cabot
- An Orange Line facility at Wellington
- A Blue Line facility at Orient Heights
- Green Line facilities at Boston College, Riverside, Reservoir, and Mattapan Yard (the Mattapan High Speed Line is operated by the Green Line since it is light rail)
- A main subway repair facility in Everett

All maintenance facilities have useful lives of 50 years. Included under this program are the basic structures of each facility: its roof, electrical systems, and major critical maintenance equipment (lifts, hoists, etc.).

The majority of this funding for subway maintenance facilities is devoted to the renovation of the Orient Heights Car House as part of the Blue Line Modernization project.

FUND PROJECTS

There are currently six projects relating to subway maintenance facilities. The first effort, the rehabilitation and expansion of the 1950s-era Orient Heights Car House, is related to the Blue Line modernization project to accommodate a larger fleet of six-car trains. The other three projects involve smaller-scale repairs to Everett and Cabot and elsewhere. All of these projects will have a neutral impact on the Authority’s operating budget.

- **Blue Line Orient Heights Car House**
  This project is being performed as part of the Blue Line Modernization effort. The project involves renovating the maintenance facility, adding new storage and maintenance tracks for larger fleets, and making preparations for six-car trains. To operate six-car trains, new capacities and functions are needed at this facility.

- **Capital Spares Warehouse**
  This project will construct a facility to house spare parts for vehicles and other capital needs.

- **Maintenance Facilities Improvements:**
  - **Everett Subway Building Roof Repair**
    The replacement of the roof at Building #2 at Everett Shops will ensure worker safety, protect recent capital investments in the facility, and ensure productivity and efficiency in heavy maintenance for all subway lines.

  - **Wellington Maintenance Facility**
    The project involves improvements to the spray paint booth to ensure the Orange Line vehicles meet their useful life.

  - **Cabot Maintenance Facility**
    The project will fund the replacement of car hoists at the Cabot RTL Maintenance Facility.
**Riverside Carhouse Improvements**
This project is intended to replace critical carhouse maintenance equipment such as lathes, lifts and hoists.

**Systemwide Carwash Facilities Replacement**
Vehicle washing systems throughout the system would be replaced with a recycling wash system to reduce water and sewer charges. All wash equipment would be modified to accommodate a water stripper system.

**Cabot Floor Rehabilitation**
This project performs structural repair work to the concrete slab flooring at the Cabot subway facility on the Red Line. The effort will reinforce the stability of the floor on which heavy rail vehicles are hoisted, and enhance the safety of maintenance workers.

### Subway Maintenance Facilities Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY07</th>
<th>FY08</th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
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### ANTICIPATED FUTURE NEEDS

The following projects have been identified as future needs for subway maintenance facilities.

**Red Line**
This project would replace the Cabot facility and expand the shop, the office and staff facilities.

**Orange Line**
This effort would renovate the Wellington facility. It would also add a second rinse unit and construct a separate storage facility for non-revenue vehicles.

**Green Line**
This project will replace and overhaul doors and overhead doors at the Reservoir facility on an as-needed basis. The lifts will perform minor repairs to the brick exterior.
COMMUTER RAIL MAINTENANCE FACILITIES

Commuter rail maintenance facilities include the Boston Engine Terminal (BET) in Somerville, the Service and Inspection facility (S&I) in South Boston, and the Light Inspection facility in Readville.

The Boston Engine Terminal is a new state-of-the-art facility constructed in 1997 and consists of over 8 acres under one roof. The building, located about one mile northwest of North Station, consists of areas for service and inspection, periodic maintenance, wheel truing, coach repair and locomotive repair along with allied shops.

The southside Service and Inspection facility is a two-track structure located at Wydett Circle in South Boston, approximately one mile south of South Station. This facility can accommodate two 9-car trains and has fueling and sanding capabilities as well as the ability to perform running repairs.

The Readville Light Inspection facility was constructed in the same time period as the BET. This facility consists of three tracks and has the capacity to hold six coaches. It is dedicated to special projects such as retrofits, wheel truing, and other maintenance.

Commuter rail maintenance facilities, including the basic structure, roof, and critical internal maintenance equipment, have useful lives of 50 years.

FUNDED PROJECTS

There is one project for commuter rail maintenance facilities.

**Commuter Rail Facilities Upgrade**

This effort will fund work for various commuter rail facility needs, including fire alarm upgrades, fan and vent installation, and environmental and safety improvements. This project will have a neutral impact on the MBTA’s operating costs.

<table>
<thead>
<tr>
<th>Commuter Rail Maintenance Facilities Projects ($ in millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PROJECT</td>
</tr>
<tr>
<td>---------</td>
</tr>
<tr>
<td>Commuter Rail Fac. Upgrades</td>
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<tr>
<td>Total Comm. Rail Maintenance</td>
</tr>
</tbody>
</table>
ANTICIPATED FUTURE NEEDS

The following projects have been identified as future needs for commuter rail maintenance facilities.

- **Maintenance Facility Upgrade Program—Readville**
  An upgrade program for replacement of the Readville facility is anticipated.

- **Maintenance Facility Upgrade Program—S&I Facility**
  A future upgrade program is anticipated for the Service and Inspection facility. Included within this program is the installation of new vandal-proof stations with features required for enhanced fire alarm service, and the installation of two new firefighter service panels with all-control wiring.

- **Midday Layover Facility**
  This project would involve the design, acquisition, and construction of additional midday storage for trains used in southside operations.
BUS MAINTENANCE FACILITIES

The Authority maintains eleven bus garages and one central bus repair shop:

- Albany Street (built in 1941);
- Arborway (built in 2004);
- Bartlett (built in 1931, closed in 2004);
- Cabot (built in 1975);
- Charlestown (built in 1979);
- Fellsway (built in 1925);
- Lynn (built in 1936);
- North Cambridge (built in 1950);
- Quincy (built in 1930);
- Southampton Street (built in 2004); and
- Everett Central repair shop.

Bus maintenance facilities have a useful life of 50 years. Included under this program are the basic structures of each facility, including its roof, electrical systems, and major critical maintenance equipment (lifts, hoists, etc.). The majority of the funding in this program is for the design and construction of a new bus facility at the Arborway, and the retrofit of existing bus facilities to service CNG vehicles. These efforts will replace Bartlett garage and will permit the full service and maintenance of the new CNG vehicles that are currently being introduced (see Bus Revenue Vehicles section).

FUNDED PROJECTS

There are 7 projects under bus maintenance facilities. The majority of this funding is to construct new and modernize existing bus facilities throughout the system, primarily driven by work required to accommodate new CNG buses. With the exception of the Quincy Bus Gasoline Fuel and Lynn Bus Facility Heaters projects, all of these projects will have a neutral impact on the Authority’s operating budget.

☑ Southampton Street Bus Facility
This project involves the design and construction of a new CNG bus maintenance and storage facility in South Boston. This facility will serve the Silver Line as well as CNG buses employed in standard bus operations. The project listed here represents the majority of the cost to construct the entire facility, while the remainder of the construction cost is part of the Silver Line Phase II project (see the Silver Line Expansion section).

☑ Arborway Bus Facility
The major project involves the design and construction of a full-scale bus maintenance and storage facility at the Arborway Yard. The facility, which opened in 2004, has permitted the aged and undersized Bartlett garage to be shuttered. Temporary facilities have opened for service while the implementation of the permanent portion of this project is underway.

☑ CNG Facility Retrofit Construction
This project involves the conversion and retrofit of existing facilities (Cabot, Charlestown, and Everett) to fuel, store and maintain CNG buses. This includes all work to construct new fueling stations, upgrade structural capacity, replace roof structures, and install all necessary sprinkler, fire, and security systems. In addition, the project will equip the Everett automotive shop with new dynamometers that allow service personnel to test bus engines, transmissions, and chassis, increasing the engines’ serviceability and reliability.
**Cabot Bus Facility Upgrade**
This project will repair or install equipment such as bus lifts, the bus washer system, overhead doors and compressed air and lubrication systems. This will help improve the facility in preparation for its conversion to a CNG facility.

**Miscellaneous Bus Facilities Upgrade**
This project encompasses a wide range of modernization, component upgrades, CNG compliance efforts, normal capital maintenance, and safety improvements at the MBTA’s bus garages. The program will substantially modernize these aging garages and prepare them to service the new MBTA bus fleets. The scope includes replacing garage bay doors and lift hoists at Lynn, Quincy, and Charlestown; repairing the roof structures at Charlestown, Lynn, and Cabot; making minor repairs to the bus wash system at Fellsway; purchasing cleaning equipment at Lynn and Charlestown; installing emergency lighting at Quincy; converting sprinkler systems systemwide; and installing gas-fired heaters at Lynn. The project has recently completed the installation of a new fuel distribution system at Quincy. Facilities systemwide will receive new bus wash air curtains, overhead cranes, and fall restraints. Finally, the North Cambridge car house will undergo a series of upgrades in preparation for the new fleet of Electric Trolley Buses.

These efforts will have a neutral or positive effect on the MBTA’s operating budget. While many projects reflect normal preventive maintenance, others permit efficiencies and increases in productivity, generating operating savings.

**Systemwide Roof Rehabilitation**
This project provides for the replacement and rehabilitation of roofs and other infrastructure at various bus facilities.

**Bus Facility Needs Assessment**
This project is a master planning study of future bus maintenance facility needs. The project is assessing the needs of the bus fleet over the long term, and it provides the studies necessary in the first step towards building a new bus facility. The proposed facility could provide expanded space and equipment for the housing and maintenance of the MBTA bus fleet in the future.

### Bus Maintenance Facilities Projects ($ in millions)

<table>
<thead>
<tr>
<th>PROJECT</th>
<th>Authorized Budget</th>
<th>Proj. Spending thru FY06</th>
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<th>FY08</th>
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</table>

**ANTICIPATED FUTURE NEEDS**
There are two future bus facility projects anticipated. In addition, due to the aging of bus facilities, various exterior structural projects are also anticipated.

**Charlestown Compressor Systems Replacement**
This project involves the replacement of existing compressors with new compressors and air dryers at the Charlestown Bus Repair Garage.

**Bus Washer Upgrades**
The Authority anticipates making several improvements to the bus washing systems at several garages in the future.
SYSTEMWIDE MAINTENANCE FACILITIES

Systemwide maintenance facilities include structures and buildings used by the Authority for various tasks and purposes. There are 17 systemwide maintenance facilities as follows:

- Cabot Heating Plant
- Auto Repair Facility
- Signal Repair Facility
- MOW Training and Backup Facility
- Testing Lab
- Materials Storehouse
- Oak Square Emergency Garage
- Campbell’s Gate MOW
- Everett Shops (systemwide)
- Arborway
- Truck Storage and Repair
- Rail Bending Shop
- Light Maintenance Shop
- Heavy Maintenance Shop
- Pipefitter’s Building
- Rice Buildings
- Salt Sheds

All systemwide maintenance facilities have a useful life of 50 years.

FUNDED PROJECTS

Currently, the Authority has not programmed capital projects for the systemwide maintenance facilities program.

ANTICIPATED FUTURE NEEDS

The projects listed below have been identified as future needs for systemwide maintenance facilities.

- **Charlestown Heating Plant**
  This project would involve the installation of a new gas-fired boiler system at Charlestown buildings No. 2 and No. 3.

- **Charlestown Roof Replacement**
  This project would involve replacing the rooftop and air conditioning system at Charlestown.