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Advisory Committee Meeting Presentation

OCTOBER 18, 2019

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Purpose of Today's Meeting

1. Welcome
2. Status Update: Alternatives 1-3
3. Review of Alternatives
4. Preliminary Findings: Alternatives 4-6
5. Additional Findings: Air Quality, Equity
6. Next Steps
7. Public Comment

Status Update

Updates since July Preliminary Results: Fleet Sizing

- Incorporated peak direction demands from CTPS for all alternatives
- Adjusted acceptable crowding assumptions to 110%, consistent with MBTA Service Delivery Policy
- Adjusted assumptions to use bi-level EMUs, which are not currently in production but could be produced for a large order
- Removed additional consists for midday servicing for electric alternatives, assuming that all maintenance occurs outside of scheduled operations
  - Additional fleet required for midday servicing continued to be assumed for diesel alternatives, which will require fueling
- Adjusted minimum diesel consist length to four cars to reflect operating capabilities

Updates since July Preliminary Results: Fleet Costs

- Identified value of additional future investments beyond those planned that would be required to bring existing locomotive fleet to State of Good Repair and to bring existing coach fleet to consist of fully bi-level coaches
  - For diesel or partial diesel fleets, these updates were assumed to occur outside of Rail Vision (costs included for Alternatives 1, 2, 4, and 5 do not include these investments)
  - For fully electric fleets, the updates would not be needed since the fleet would transition to EMUs – the cost of the updates was instead applied as a credit to the EMU procurement (reducing the costs included in Alternative 3 and 6)

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Updated Alternative 1-3 Results*

DRAFT – final values in development, numbers may vary

	Alternative 1: Higher Frequency Commuter Rail	Alternative 2: Regional Rail to Key Stations (Diesel)	Alternative 3: Regional Rail to Key Stations (Electric)
2040 Ridership (Compared to No-Build)	Increase of **19,000** daily boardings **(13%)** on Commuter Rail • North Side: **8,600 (19%)** • South Side: **10,400 (10%)** **9,200** new linked transit trips in system	Increase of **36,200** daily boardings **(24%)** on Commuter Rail • North Side: **24,100 (52%)** • South Side: **12,100 (12%)** **21,200** new linked transit trips in system	Increase of **52,900** daily boardings **(35%)** on Commuter Rail • North Side: **28,500 (62%)** • South Side: **24,400 (23%)** **35,800** new linked transit trips in system
Fleet Needs	Diesel Locomotives Bi-Level Cab Cars/Coaches	Diesel Locomotives Electric Locomotives Bi-Level Cab Cars/Coaches	Bi-level EMUs
Preliminary Capital Costs (2020$/2030$)	**$1.7B (2020$)/$2.3B (2030$)**	**$4.5B (2020$)/$6.3B(2030$)**	**$17.9B (2020$)/$25.2B(2030$)**
Annualized Gross O&M Costs (2020$) Increase/Year	**+$130M/Year**	**+$379M/Year**	**+$439M/Year**
2040 Auto Usage Reductions from No-Build, Select Statistics	-60.2 million VMT per year (-0.1%) -7.9 million VHT per year (-0.3%) -2.6 million auto-person trips per year (-0.03%)	-189.6 million VMT per year (-0.3%) -44.9 million VHT per year (-1.8%) -11.2 million auto-person trips per year (-0.12%)	-261.7 million VMT per year (-0.4%) -52.9 million VHT per year (-2.1%) -15.3 million auto-person trips per year (-0.16%)
Equity: EJ Population not More Adversely Affected than Non-EJ	✓	✓	✓

*Updates highlighted in purple

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Review of Alternatives

Review of Alternatives – Key Characteristics

	Alternative 4: Urban Rail (Diesel)	Alternative 5: Urban Rail (Electric)	Alternative 6: Full Transformation
Objective	Provide **high-frequency, rapid-transit-like service to stations in the inner core with DMUs**	Provide **high-frequency, rapid-transit-like service to stations in the inner core with EMUs**	**High-frequency service throughout the network with EMUs**
Typical Frequency (Peak min/Off-Peak min Headway)	Inner Core: **15/15** bi-directional All Other Stations: **30/60** bi-directional	Inner Core: **15/15** bi-directional All Other Stations: **30/60** bi-directional	Key Stations: **15/15** bi-directional Inner Core: **15/15** bi-directional Outer Stations: **15/15** bi-directional where possible
Station Accessibility	**All Inner Core Stations** would have high-level boarding platforms	**All Inner Core Stations** would have high-level boarding platforms	**All Stations** would have high-level boarding platforms
Electrification	None	**Urban rail service** would be electrified Service on the **Providence Line** and **South Coast Rail** would be electrified	The full system would be electrified
Train Type(s)	**Single-Level Diesel Multiple Units (DMUs)** Diesel Locomotives	**Bi-Level Electric Multiple Units (EMUs)** Diesel + Electric Locomotives	Bi-Level Electric Multiple Units (EMUs)
Major Expansions	South Station Expansion **South Coast Rail Phase 1**	South Station Expansion **South Coast Rail Full Build** **Grand Junction (Shuttle)**	North South Rail Link South Coast Rail Full Build Grand Junction (Shuttle) Foxboro

Preliminary Findings: Alternatives 4-6

Preliminary Findings: Alternative 4 Urban Rail (Diesel)

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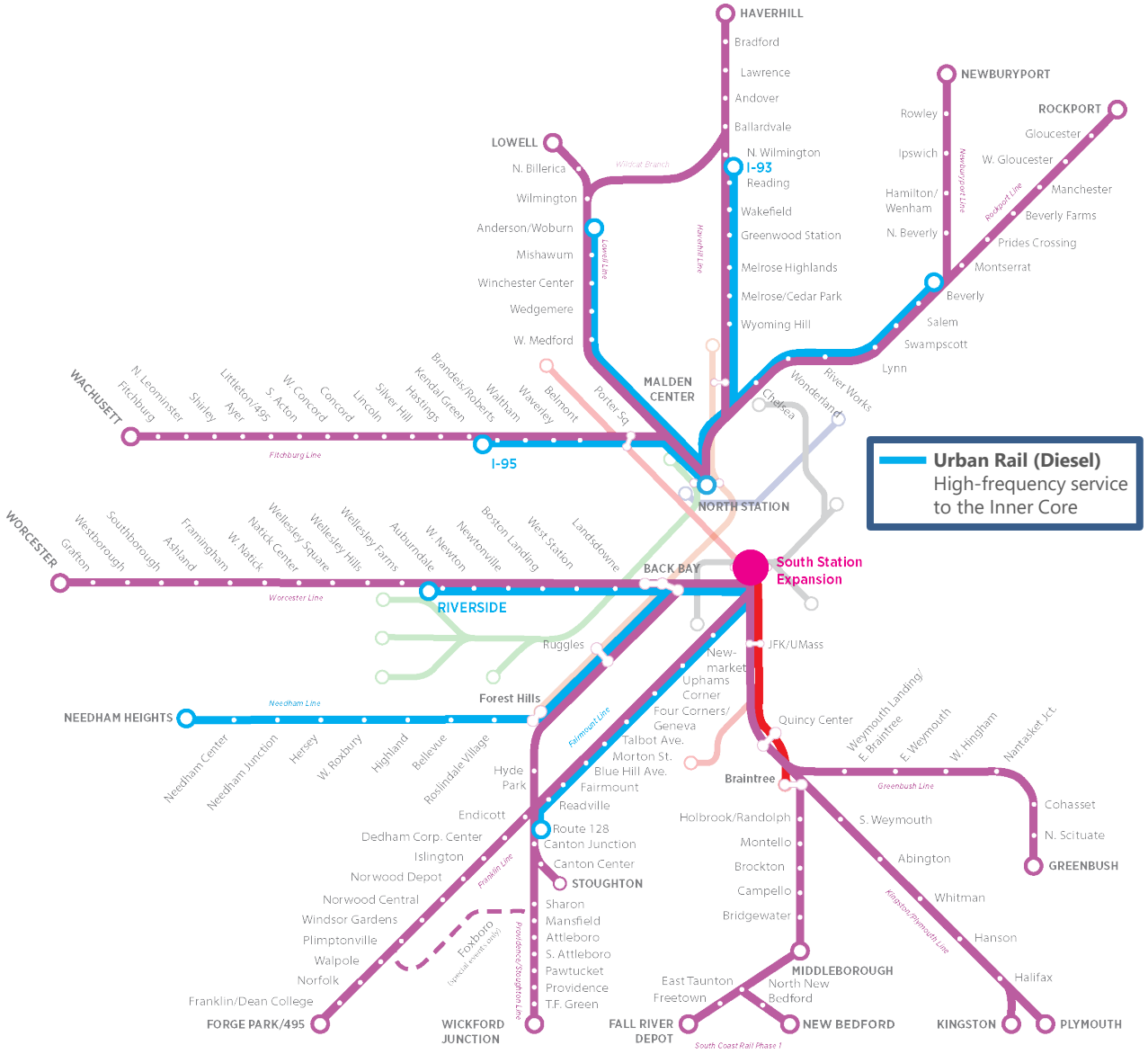
Alternative 4: Urban Rail (Diesel)

Goal:
Focuses on urban rail – high-frequency, rapid-transit-like service to stations in the inner core – using flexible diesel-powered train sets called diesel multiple units (DMUs) that can vary in train size to meet demand. Stations in the outer regions of the system would receive more modest increases in service.

Key Features	
Typical Frequency (Peak/Off-Peak)	Inner Core: 15/15 bi-directional All Other Stations: 30/60 bi-directional
Station Accessibility	All Inner Core Stations would have high-level boarding platforms
Electrification	None
Train Type(s)	Diesel Locomotives Single-Level Diesel Multiple Units (DMUs)
Major Expansions	South Station Expansion South Coast Rail Phase 1



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Alternative 4: Urban Rail (Diesel) – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- Assumes current fares; **unconstrained parking at Urban Rail Termini**

Daily Boardings	No-Build	Alternative 4	Change in Daily Boardings	% Change in Daily Boardings	Findings on Growth
Commuter Rail	**150,800**	**231,200**	**80,400**	**53%**	**Highest absolute growth on the South Side, but greater % increase on the North Side**
North Side	46,100	76,900	30,800	67%	Highest on Newburyport/Rockport
South Side	104,700	154,300	49,600	47%	Highest on Framingham/Worcester Line; Reductions on some lines due to diversions to other lines
Drive Access	92,800	105,400	12,600	14%	Due to unconstrained parking at urban rail termini
Walk Access	58,000	125,800	67,800	117%	Ridership increases in the dense inner core
Other Transit Modes	**1,500,500**	**1,470,100**	**-30,400**	**-2%**	**Diversions to urban rail**

Notes: Parking was modeled as unconstrained at Beverly, I-93, Anderson/Woburn, I-95, Riverside, Needham Heights, and Route 128.
Other transit modes include rapid transit, BRT, local bus (including other RTAs), express bus (including private and Logan buses), shuttle bus (including Logan and MGH shuttles), and ferry. The percentage change for other transit modes is in comparison to the No-Build demand for these modes.
Emissions, equity, and connectivity will be analyzed for each alternative as part of the upcoming analysis.

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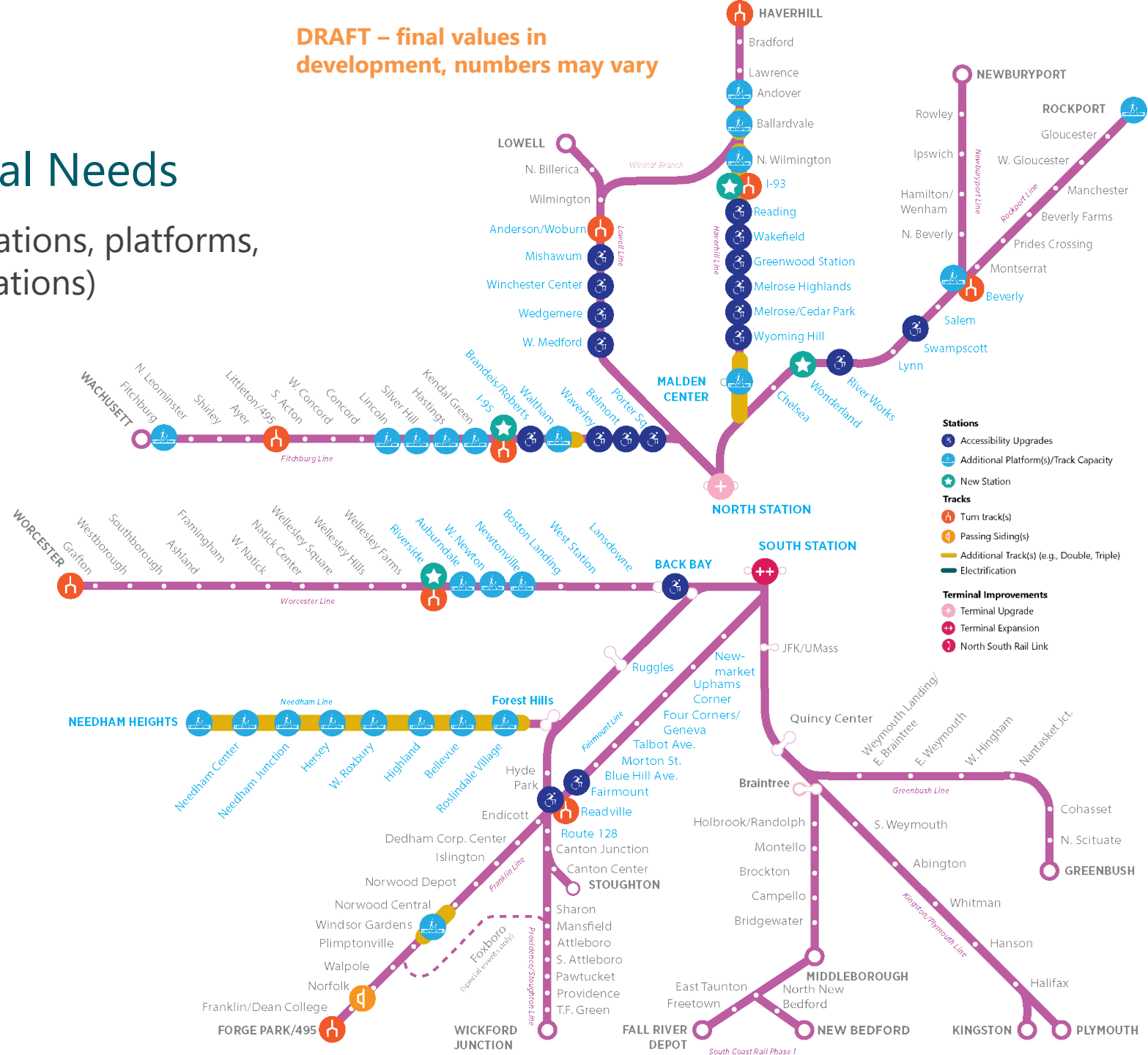
Alternative 4: Preliminary Capital Needs

- Station improvements, including new stations, platforms, tracks, and accessibility upgrades (47 stations)
- Additional track mileage (~24 miles)
- Signals and systems upgrades
- Grade crossing upgrades (21)
- Bridge/Structure improvements or replacements (49)
- Fleet Needs:
  - Equipment
    - Diesel Locomotives
    - Bi-Level Cab Cars and Coaches
    - DMUs
  - Maintenance and Layover areas
- Expansions:
  - South Station Expansion
  - South Coast Rail Phase 1



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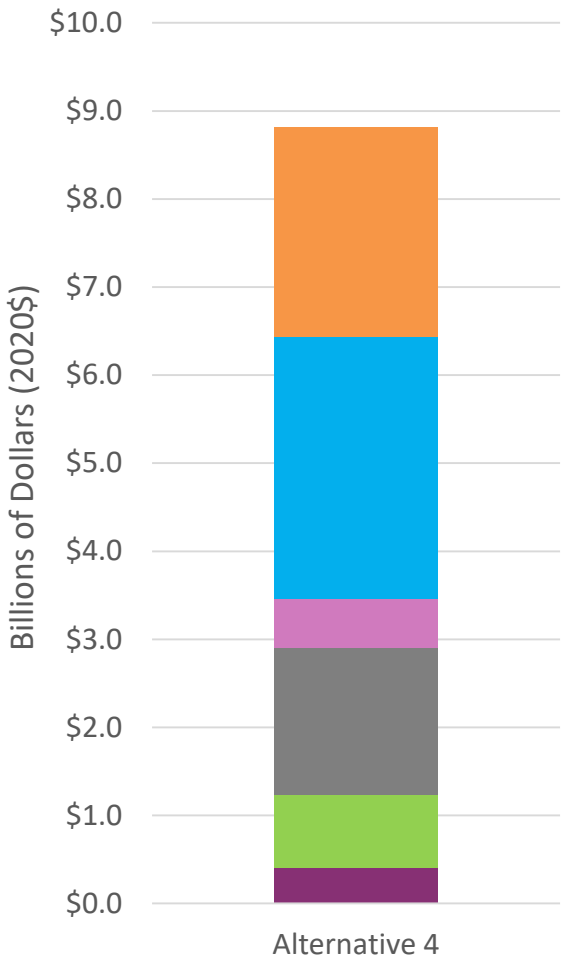
Alternative 4: Urban Rail (Diesel) – Preliminary Capital Costs



Preliminary Capital Costs (2020$/2030$)

$8.9B (2020$)/$12.6B (2030$)

Improvement Category	Cost (2020$)
Track and Signal Work	$0.4B
Structures	$0.8B
Stations	$1.7B
Layover and Maintenance Facilities	$0.6B
Fleet Procurement	$3.0B
System Expansions - South Station Expansion - Modified North Station	$2.4B

Note: Values are rounded and may not sum to total.

$8.9B (2020$)

Fleet costs are based on incremental fleet, and include entirely new DMU fleet. Total fleet includes:

- 114 locomotives
- 114 bi-level cab cars
- 443 bi-level coaches
- 336 DMUs

Expansions exclude SCR Phase 1

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Preliminary Findings: Alternative 5 Urban Rail (Electric)

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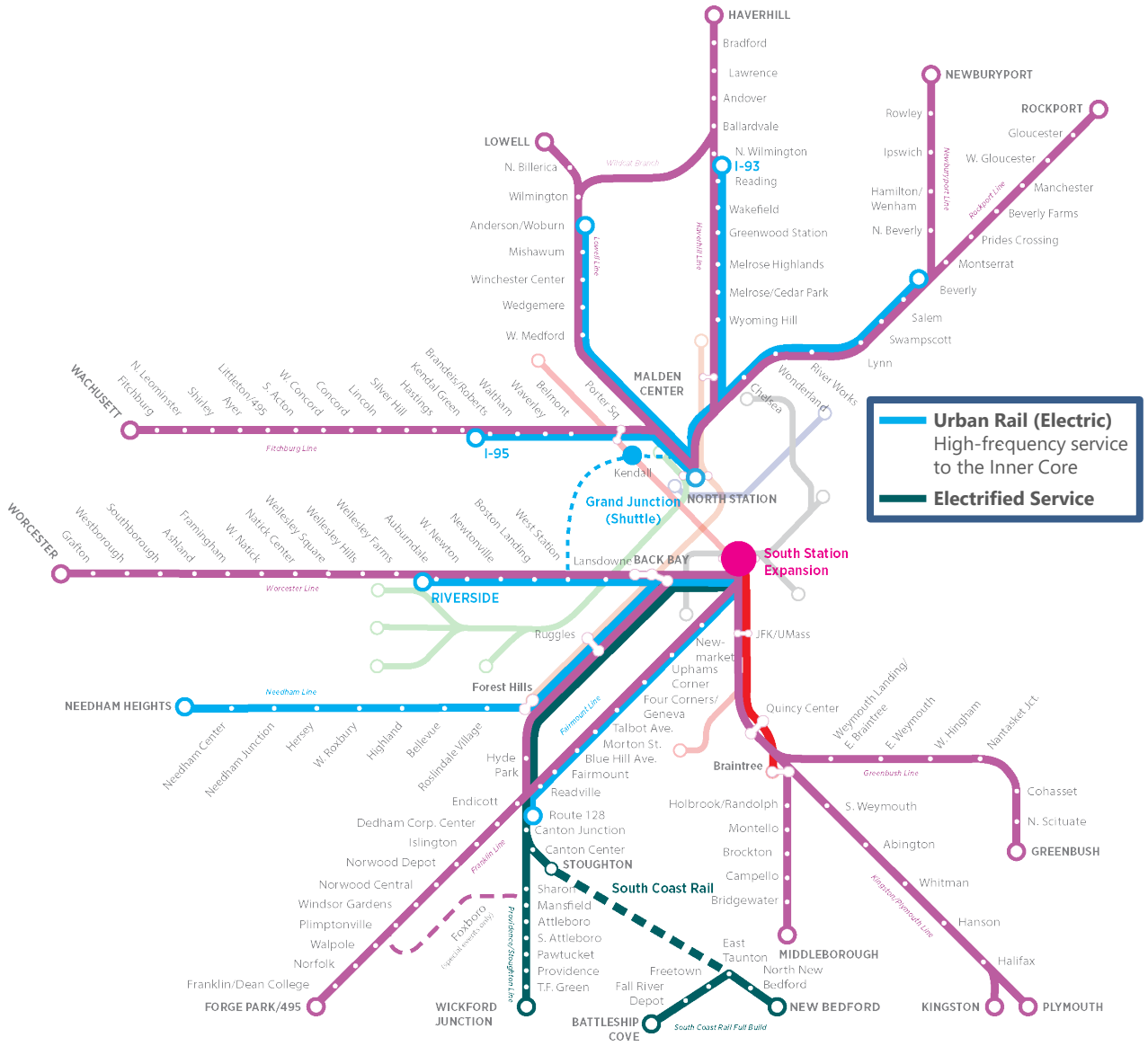
Alternative 5: Urban Rail (Electric)

Goal:

Focus on urban rail – high-frequency, rapid-transit-like service to stations in the inner core – using flexible electric-powered train sets called electric multiple units (EMUs) that can vary in train size to meet demand. Stations in the outer regions of the system would receive more modest increases in service.

Key Features	
Typical Frequency (Peak/Off-Peak)	Inner Core: 15/15 bi-directional All Other Stations: 30/60 bi-directional
Station Accessibility	All Inner Core Stations would have high-level boarding platforms
Electrification	Urban rail service would be electrified Service on the Providence Line and South Cost Rail would be electrified
Train Type(s)	Diesel + Electric Locomotives Bi-Level Electric Multiple Units (EMUs)
Major Expansions	South Station Expansion South Coast Rail Full Build Grand Junction (Shuttle)



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Alternative 5: Urban Rail (Electric) – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- Assumes current fares; **unconstrained parking at Urban Rail Termini**

Daily Boardings	No-Build	Alternative 5	Change in Daily Boardings	% Change in Daily Boardings	Findings on Growth
Commuter Rail	**150,800**	**232,400**	**81,600**	**54%**	**Highest absolute growth on the South Side, but greater % increase on the North Side**
North Side	46,100	77,000	30,900	67%	Highest on Newburyport/Rockport
South Side	104,700	155,400	50,700	48%	Highest on Framingham/Worcester Line; Reductions on some lines due to diversions to other lines
Drive Access	92,800	103,100	10,300	11%	Due to unconstrained parking at urban rail termini
Walk Access	58,000	129,300	71,300	123%	Ridership increases in the dense inner core
Other Transit Modes	**1,500,500**	**1,478,200**	**-22,300**	**-1%**	**Diversions to urban rail**

Notes: Parking was modeled as unconstrained at Beverly, I-93, Anderson/Woburn, I-95, Riverside, Needham Heights, and Route 128.
Other transit modes include rapid transit, BRT, local bus (including other RTAs), express bus (including private and Logan buses), shuttle bus (including Logan and MGH shuttles), and ferry. The percentage change for other transit modes is in comparison to the No-Build demand for these modes.
Emissions, equity, and connectivity will be analyzed for each alternative as part of the upcoming analysis.

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Alternative 5 Modified for Lower Fares: Urban Rail (Electric) – Preliminary Ridership (2040)

- A second version of Alternative 5 was modeled with **lower urban rail fares** to understand impact that fares have on ridership
- Providing a lower fare structure resulted in ridership increases of approximately 7% systemwide total daily boardings, but increases vary by line and occur through both drive and walk access

Daily Boardings	Alternative 5 Total Daily Boardings	Alternative 5 Modified for Lower Fares Total Daily Boardings	Change in Total Daily Boardings	% Change in Total Daily Boardings	Findings Related to Lower Fares
Commuter Rail	**232,400**	**249,800**	**+17,400**	**7%**	**Highest benefit on North Side**
North Side	77,000	92,200	+15,200	20%	Highest growth on Fitchburg Line; all lines at least 15% growth
South Side	155,400	157,600	+2,200	1%	Limited growth on all urban rail lines
Drive Access	103,100	112,800	+9,700	9%	Lower fares increase drive access to urban rail fare zones
Walk Access	129,300	137,000	+7,700	6%	Some increase in walk access due to lower fares
Other Transit Modes	**1,478,200**	**1,472,000**	**-6,200**	**0%**	**Diversions to urban rail greatest on Blue Line**

Notes: Parking was modeled as unconstrained at Beverly, I-93, Anderson/Woburn, I-95, Riverside, Needham Heights, and Route 128.
The modeling for the lower fare alternative assumed a flat urban rail fare between the existing Zone 1A and Zone 1 pricing. Zone 1A trips maintained Zone 1A pricing.
Other transit modes include rapid transit, BRT, local bus (including other RTAs), express bus (including private and Logan buses), shuttle bus (including Logan and MGH shuttles), and ferry. The percentage change for other transit modes is in comparison to the No-Build demand for these modes.
Emissions, equity, and connectivity will be analyzed for each alternative as part of the upcoming analysis.

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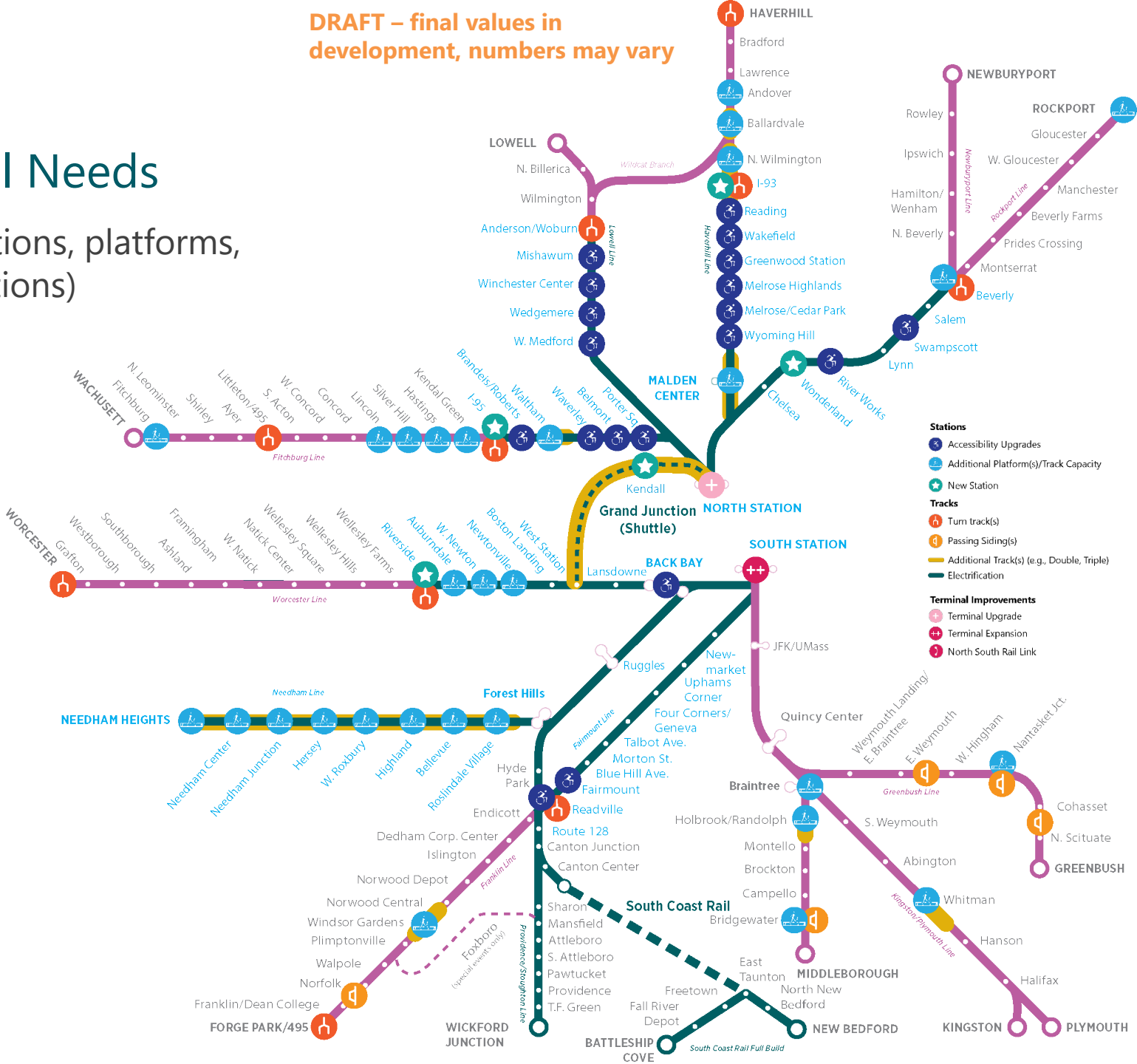
Alternative 5: Preliminary Capital Needs

- Station improvements, including new stations, platforms, tracks, and accessibility upgrades (53 stations)
- Additional track mileage (~39 miles)
- Signals and systems upgrades
- Grade crossing upgrades (40)
- Bridge/Structure improvements or replacements (58)
- Fleet Needs:
  - Equipment
    - Diesel + Electric Locomotives
    - Bi-Level Cab Cars and Coaches
    - EMUs
  - Maintenance and Layover areas
- Partial Electrification
- Expansions:
  - South Station Expansion
  - South Coast Rail Full Build
  - Grand Junction (Shuttle)



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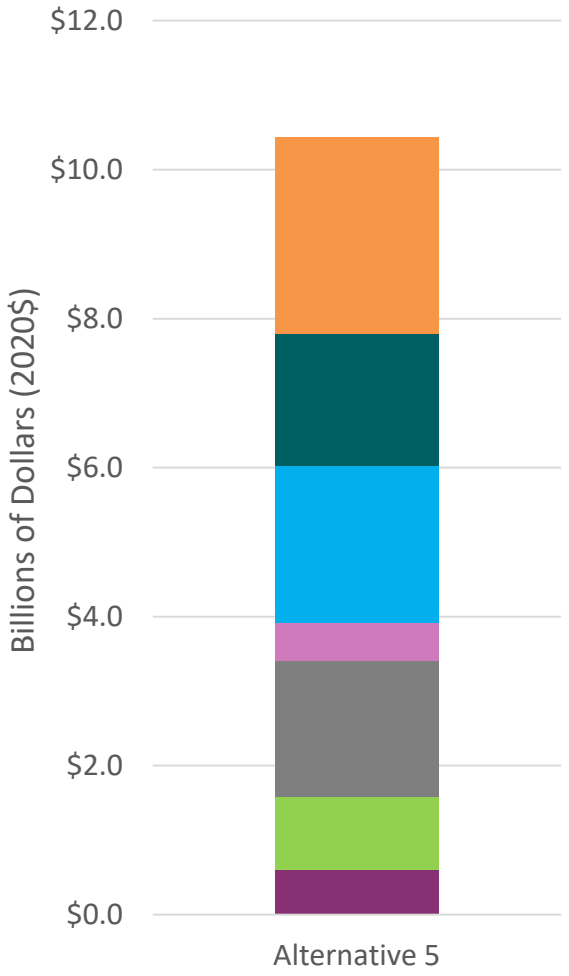
Alternative 5: Urban Rail (Electric) – Preliminary Capital Costs



Preliminary Capital Costs (2020$/2030$)

$10.6B (2020$)/$14.9B (2030$)

Improvement Category	Cost (2020$)
Track and Signal Work	$0.6B
Structures	$1.0B
Stations	$1.8B
Layover and Maintenance Facilities	$0.5B
Fleet Procurement	$2.1B
Electrification	$1.8B
System Expansions - South Station Expansion - Modified North Station - Grand Junction	$2.6B

Note: Values are rounded and may not sum to totals. **$10.6B (2020$)**

Fleet costs are based on incremental fleet, and include entirely new EMU fleet. Total fleet includes:

- 112 locomotives
- 112 bi-level cab cars
- 450 bi-level coaches
- 185 EMUs

Expansions exclude SCR Full Build

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Key Takeaways for Urban Rail Alternatives

- Ridership projections for Alternative 4 and 5 show nearly identical increases in daily boardings, **indicating that the benefit of increased frequency plays a larger role in demand than the moderate reductions in travel time associated with electrification.** Modified Alternative 5 shows that **lower fares** drive additional ridership.
- Benefits of electrification appears to lie in emissions and other associated benefits, compared to ridership.
- Alternative 5 has greater capital costs and lower O&M costs, both largely associated with the partial system electrification.

	Alternative 4: Urban Rail (Diesel)	Alternative 5: Urban Rail (Electric)	Alternative 5 Modified for Lower Fares: Urban Rail (Electric)
Core Service Components	Inner Core: 15/15 bi-directional	Inner Core: 15/15 bi-directional Moderate reductions in travel time due to electrification	Inner Core: 15/15 bi-directional Moderate reductions in travel time due to electrification
Operational Components	A mix of DMU and diesel locomotive service	Electrified urban rail service operated with EMUs Electrified service on the Providence Line and South Coast Rail	Electrified urban rail service operated with EMUs Electrified service on the Providence Line and South Coast Rail
2040 Ridership (compared to No-Build)	**+80,400** daily boardings on Commuter Rail **+47,500** new transit trips in system	**+81,600** daily boardings on Commuter Rail **+47,500** new transit trips in system	**+99,000** daily boardings on Commuter Rail **+59,100** new transit trips in system
Preliminary Capital Costs	**$8.9B (2020$)/$12.6B (2030$)**	**$10.6B (2020$)/$15.0B(2030$)**	**$10.6B (2020$)/$15.0B(2030$)**
Incremental MBTA Systemwide Revenues	**+$58M**/Year	**+$48M**/Year	**+$15M**/Year
Annualized Gross O&M Costs (2020$) Increase/Year	**+$333M/year**	**+$304M/year**	**+$304M/year**

Preliminary Findings: Alternative 6
Full Transformation

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Alternative 6: Full Transformation

Goal:
Provide a combination of regional rail and urban rail – resulting in high-frequency service throughout the network – using flexible electric-powered train sets called electric multiple units (EMUs) that can vary in train size to meet demand. North-South Rail Link provides through trips for the inner core. Nearly every station in the network would receive service every 15 minutes.

Key Features	
Typical Frequency (Peak/Off-Peak)	Key Stations: 15/15 bi-directional Inner Core: 15/15 bi-directional Outer Stations: 15/15 bi-directional where possible
Station Accessibility	All Stations would have high-level boarding platforms
Electrification	The full system would be electrified
Train Type(s)	Electric Multiple Units (EMUs)
Major Expansions	North South Rail Link South Coast Rail Full Build Grand Junction (Shuttle) Foxboro

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Alternative 6: Full Transformation – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- Assumes a flat urban rail fare (outside of Zone 1A) and non-urban rail mileage based fares; **unconstrained parking at most stations**

Daily Boardings	No-Build	Alternative 6	Change in Daily Boardings	% Change in Daily Boardings	Findings on Growth
Commuter Rail	**150,800**	**376,700**	**225,900**	**150%**	**Highest absolute growth on the South Side, but greater % increase on the North Side**
North Side	46,100	133,100	87,000	189%	Highest on Newburyport/Rockport
South Side	104,700	243,600	138,900	133%	Highest on Framingham/Worcester Line
Drive Access	92,800	187,200	94,400	102%	Unconstrained parking significantly increases drive access
Walk Access	58,000	189,500	131,500	227%	High frequency to high-density locations throughout the network results significant increase in walk access
Other Transit Modes	**1,500,500**	**1,450,400**	**-50,100**	**-3%**	**Diversions from most other transit modes**

Notes: Parking was modeled as unconstrained at all commuter rail stations that currently have at least 50 spaces and are not rapid transit stations.
The modeling assumed a flat urban rail fare between the existing Zone 1A and Zone 1 pricing. Zone 1A trips maintained Zone 1A pricing. All other fares are mileage-based.
Growth in north side and south side boardings includes NSRL ridership, and uses an approximate distribution of boardings for through-running trips.
Other transit modes include rapid transit, BRT, local bus (including other RTAs), express bus (including private and Logan buses), shuttle bus (including Logan and MGH shuttles), and ferry. The percentage change for other transit modes is in comparison to the No-Build demand for these modes.
Emissions, equity, and connectivity will be analyzed for each alternative as part of the upcoming analysis.

Ridership Growth Analysis for Alternative 6 – Full Transformation

- Growth in ridership (+225,900 daily boardings) reflects three factors – **unconstrained parking, reduced fares,** and **improved service**. Comparing Alternative 6 ridership projections with other Alternatives and baseline data provides insight into how to interpret these results and understand how each factor influenced them.
  - **Parking:** Alternative 6 projects over 94,000 new "drive access" boardings, which equates to up to 47,000 parking spaces. Some of the new boardings in Alternative 6 may be a result of unlocking parking access, rather than service changes. However, Alternative 6 also projects over 131,000 new "walk access" boardings, attributable to improved fares and service.
  - **Fares:** Alternative 6 and a variation of Alternative 5 model a lower fare than exists today for inner core stations outside of Zone 1A, inducing an increase in boardings. Applying the existing fare structure to Alternative 6 would likely result in a reduction of systemwide ridership. For example, comparing the ridership between Alternative 5 and its lower fare variation resulted in an increase of 17,400 total daily boardings systemwide.
  - **Service:** The analysis demonstrates that a portion of ridership is attributable to the increased frequency of 15 minutes systemwide, reduced travel times, and improved connectivity from North South Rail Link modeled in Alternative 6. Preliminary estimates show approximately 35,000 daily boardings using new through-service via North South Rail Link, some of which currently occur on rapid transit.

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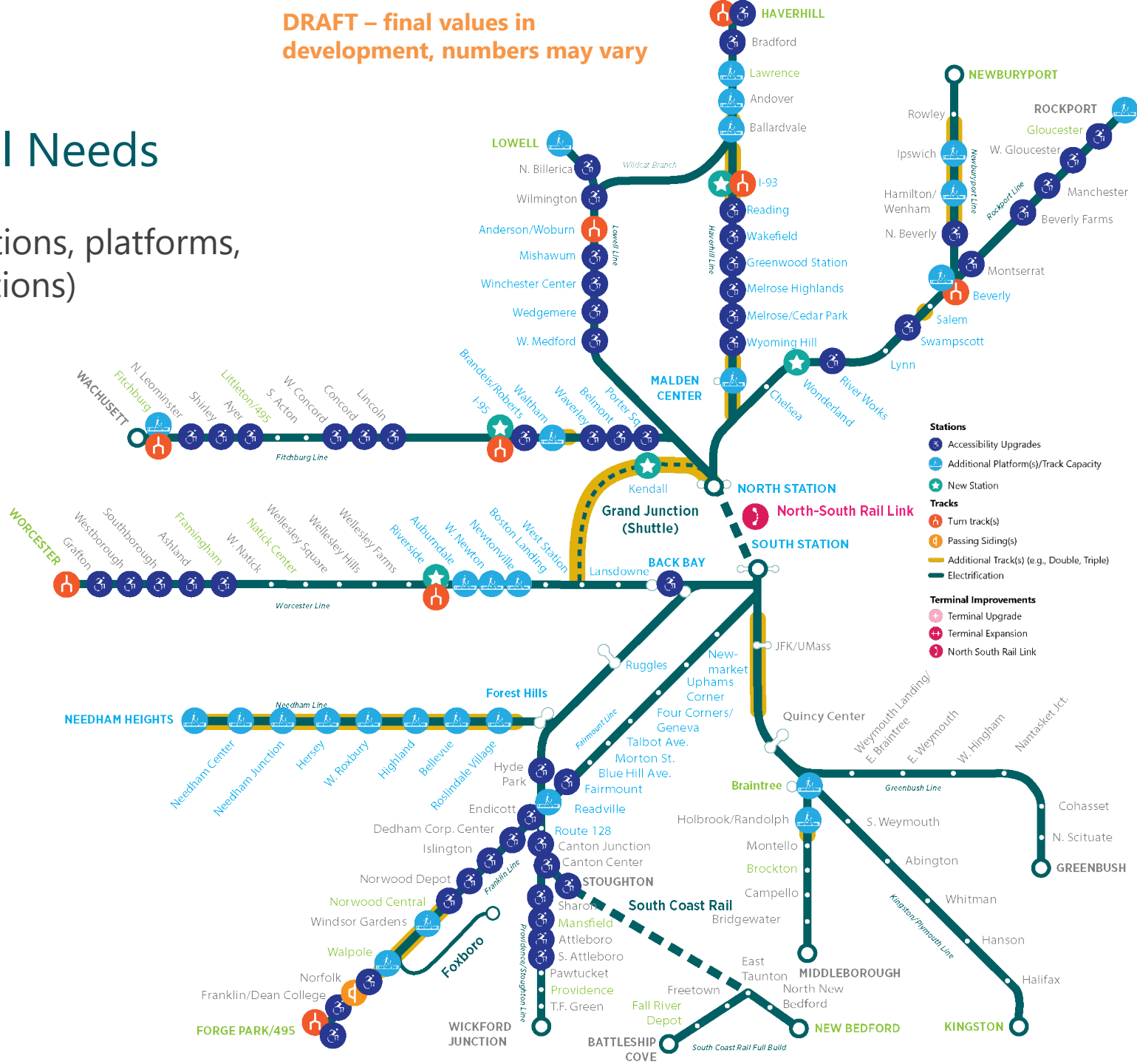
Alternative 6: Preliminary Capital Needs

- Station improvements, including new stations, platforms, tracks, and accessibility upgrades (87 stations)
- Additional track mileage (~59 miles)
- Signals and systems upgrades
- Grade crossing upgrades (35)
- Bridge/Structure improvements or replacements (82)
- Fleet Needs:
  - Equipment (EMUs)
  - Maintenance and Layover areas
- Electrification
- Expansions:
  - North South Rail Link
  - South Coast Rail Full Build
  - Grand Junction (Shuttle)
  - Foxboro



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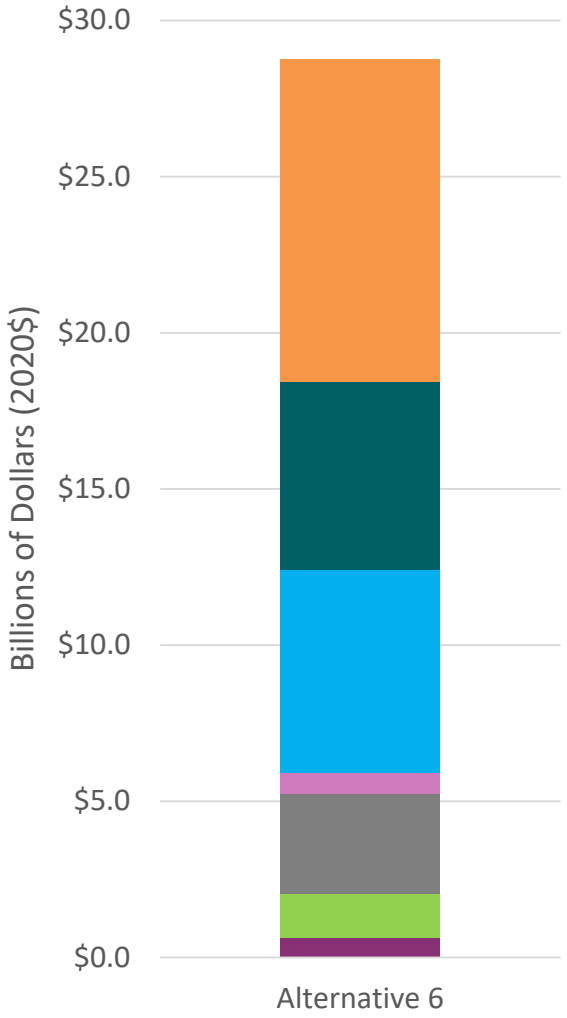
Alternative 6: Full Transformation – Preliminary Capital Costs



Preliminary Capital Costs (2020$/2030$)

$28.9B (2020$)/$40.7B (2030$)

Improvement Category	Cost (2020$)
Track and Signal Work	**$0.6B**
Structures	**$1.4B**
Stations	**$3.2B**
Layover and Maintenance Facilities	**$0.7B**
Fleet Procurement	**$6.5B**
Electrification	**$6.0B**
System Expansions - North South Rail Link (Including Modifications)* - Grand Junction - Old Colony Braintree to S Station Double Track	**$10.3B**

Note: Values are rounded and may not sum to totals. **$28.9B (2020$)**

Fleet costs are based on need for entire new electric fleet. Total fleet includes:

- 964 EMUs

Expansions exclude SCR Full Build and Foxboro

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Summary of Alternatives 1- 6

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Review of Operations Assumptions

Service Assumptions	Operations Assumptions
On-time performance goal: 92%	**O&M unit costs:** Based on current MBTA cost data, with the exception of electrified service and DMUs (based on experience from other US agencies)*
Span of service: 6 AM to 12 AM	**Staffing:** Average number of staff per train, based on today's staffing requirements
Service levels: Bidirectional, at least hourly all day	**Maximum speeds:** 79 mph, with the exception of SCR Full Build (100 mph)
Amtrak service: Based on future NEC service plan, NEC service to include 1 Acela and 1 regional per hour per direction; 7 daily Downeaster round trips	**Turn times:** 15-minute minimum for long-distance trips and 10-minute minimum for urban rail trips (both times include recovery)
PTC: Installed on all lines	**Midday servicing:** Required for diesel-powered trains but not electric-powered trains
Platform accessibility: Defined by alternative, with high-level platforms resulting in lower dwell times	**Spare ratios:** Assumed to be 20% for most fleet types (higher for DMUs and small fleets)

***Note:** Costs in the US may differ from costs internationally due to regulations, costs of diesel fuel, cost of electricity, etc.

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O&M Costs and Revenues in Alternatives 1-6

- Each alternative results in a change in systemwide revenue and commuter rail O&M costs
- Revenue increases are due to ridership gains, which are partially offset by shifts from higher zone stations to lower zone stations (due to the differences across stations in frequency, unconstrained parking, or fares)
- Systemwide revenues do not account for non-fare revenue sources (e.g., parking)
- O&M costs do not reflect potential changes in O&M costs on other modes (e.g., bus, rapid transit)

Annualized Increase/Year (in 2020$)	**Alternative 1:** Higher Frequency Commuter Rail	**Alternative 2:** Regional Rail to Key Stations (Diesel)	**Alternative 3:** Regional Rail to Key Stations (Electric)	**Alternative 4:** Urban Rail (Diesel)	**Alternative 5:** Urban Rail (Electric)	**Alternative 5:** Urban Rail (Electric) with Modified Fares	**Alternative 6:** Full Transformation
Incremental MBTA Systemwide Revenues	$29M/Year	$52M/Year	$52M/Year	$58M/Year	$48M/Year	$15M/Year	$80M/Year
Incremental MBTA Commuter Rail O&M Costs	$130M/Year	$379M/Year	$439M/Year	$333M/year	$304M/year	$304M/year	$643M/year

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Parking Capacity and Demand in Alternatives 1-6

- Ridership increases are partially driven by unconstrained parking for Alternatives 2-6
- Drive access boardings increase in all alternatives
- Drive access comparison to existing capacity demonstrates a need for additional parking to support the projected ridership

	Approximate Existing Parking Availability	**Alternative 1:** Higher Frequency Commuter Rail	**Alternative 2:** Regional Rail to Key Stations (Diesel)	**Alternative 3:** Regional Rail to Key Stations (Electric)	**Alternative 4:** Urban Rail (Diesel)	**Alternative 5:** Urban Rail (Electric)	**Alternative 6:** Full Transformation
Daily Drive Access Boardings (2040)	~43,000 Spaces Exist Today (Includes both Public and Private)	98,100	103,000	112,200	105,400	103,100	187,200
Additional Parking Spaces Required*		~10,000	~15,000	~21,000	~16,000	~16,000	~45,000

Note: Parking capacities were estimated for each station based on the Boston MPO *2012-13 Inventory of Park-and-Ride Lots at MBTA Facilities*, and was updated based on the MBTA website and further review. Station-level estimates include MBTA facilities as well as municipal and private facilities. Station-level estimates were aggregated to the line-level and compared to line-level drive access boardings, assuming that every two drive access boardings (one inbound and one outbound boarding) requires one parking space. This results in a conservative estimate of the additional parking spaces required as it does not account for potential kiss-and-ride boardings included in the drive access totals, and assumes all drive access boardings are in single-occupancy vehicles. For Alternative 6, drive access boardings on trips traveling through the North South Rail Link were distributed to the line level based on the period-level directional ridership.

RAIL VISION

Comparison of Alternatives 1-6 – Preliminary Results

DRAFT – final values in development, numbers may vary

	Alternative 1: Higher Frequency Commuter Rail	**Alternative 2:** Regional Rail to Key Stations (Diesel)	**Alternative 3:** Regional Rail to Key Stations (Electric)	**Alternative 4:** Urban Rail (Diesel)	**Alternative 5:** Urban Rail (Electric)	**Alternative 5:** Urban Rail (Electric) with Modified Fares	**Alternative 6:** Full Transformation
2040 Ridership (compared to No-Build)	+**19,000** daily CR boardings **(+13%)** *+5,300 drive access* *+13,700 walk access* +**9,200** new linked transit trips in system	+**36,200** daily CR boardings **(+24%)** *+10,200 drive access* *+26,000 walk access* +**21,200** new linked transit trips in system	+**52,900** daily CR boardings **(+35%)** *+19,400 drive access* *+33,500 walk access* +**35,800** new linked transit trips in system	+**80,400** daily CR boardings **(+53%)** *+12,600 drive access* *+67,800 walk access* +**47,500** new transit trips in system	+**81,600** daily CR boardings **(+54%)** *+10,300 drive access* *+71,300 walk access* +**47,500** new transit trips in system	+**99,000** daily CR boardings **(+66%)** *+20,000 drive access* *+79,000 walk access* +**59,100** new transit trips in system	+**225,900** daily CR boardings **(+150%)** *+94,400 drive access* *+131,500 walk access* +**122,400** new transit trips in system
Assumptions: *-Fare Structure*	*-Current fares*	*-Current fares*	*-Current fares*	*-Current fares*	*-Current fares*	***-Urban rail fares***	***-Urban rail fares and distance-based fares***
-Parking	*-Parking constrained*	***-Parking unconstrained at most key stations***	***-Parking unconstrained at most key stations***	***-Parking unconstrained at urban rail termini***	***-Parking unconstrained at urban rail termini***	***-Parking unconstrained at urban rail termini***	***-Parking unconstrained at all stations (excluding rapid transit & limited parking stations)***
Fleet Needs	Diesel Locomotives Bi-Level Cab Cars/Coaches	Locomotives Bi-Level Cab Cars/Coaches	Bi-level EMUs	Diesel Locomotives Bi-Level Cab Cars/Coaches Single-Level DMUs	Locomotives Bi-Level Cab Cars/Coaches Bi-Level EMUs	Locomotives Bi-Level Cab Cars/Coaches Bi-Level EMUs	Bi-Level EMUs
Preliminary Capital Costs (2020$/ 2030$)	**$1.7B** (2020$)/ **$2.3B** (2030$)	**$4.5B** (2020$)/ **$6.3B** (2030$)	**$17.9B** (2020$)/ **$25.2B** (2030$)	**$8.9B** (2020$)/ **$12.6B** (2030$)	**$10.6B** (2020$)/ **$14.9B** (2030$)	**$10.6B** (2020$)/ **$14.9B** (2030$)	**$28.9B** (2020$)/ **$40.7B** (2030$)
Incremental MBTA Systemwide Revenues (2020$)	**$29M**/Year	**$52M**/Year	**$52M**/Year	**$58M**/Year	**$48M**/Year	**$15M**/Year	**$80M**/Year
Incremental MBTA Commuter Rail O&M Costs (2020$)	**$130M**/Year	**$379M**/Year	**$439M**/Year	**$333M**/year	**$304M**/year	**$304M**/year	**$643M**/year

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Note: incremental revenues cost do not account for changes in non-fare revenue sources (e.g., parking). Incremental O&M costs do not account for changes in O&M costs on other modes.

Additional Findings: Air Quality, Equity

DRAFT – final values in development, numbers may vary

Automobile Use Projections

- Reductions in vehicle use, as well as auto diversions identified for all alternatives and compared to No Build statewide totals
- Percentage reduction in VHT greater than percentage reduction in VMT

Compared to No-Build	**Alternative 1:** Higher Frequency Commuter Rail	**Alternative 2:** Regional Rail to Key Stations (Diesel)	**Alternative 3:** Regional Rail to Key Stations (Electric)	**Alternative 4:** Urban Rail (Diesel)	**Alternative 5:** Urban Rail (Electric)	**Alternative 6:** Full Transformation
Change in Annual Vehicle Miles Traveled (VMT) (miles/year) ***(% change statewide)***	-60.2 Million *(-0.1%)*	-189.6 Million *(-0.3%)*	-261.7 Million *(-0.4%)*	-174.3 Million *(-0.3%)*	-166.8 Million *(-0.2%)*	-428.4 Million *(-0.6%)*
Change in Annual Vehicle Hours Traveled (VHT) (hours/year) ***(% change statewide)***	-7.9 Million *(-0.3%)*	-44.9 Million *(-1.8%)*	-52.9 Million *(-2.1%)*	-39.6 Million *(-1.6%)*	-37.5 Million *(-1.5%)*	-66.0 Million *(-2.7%)*
Change in Annual Auto Person Trips ***(% change statewide)***	-2.6 Million *(-0.03%)*	-11.2 Million *(-0.12%)*	-15.3 Million *(-0.16%)*	-19.8 Million *(-0.21%)*	-18.8 Million *(-0.20%)*	-36.8 Million *(-0.39%)*

Note: VMT and VHT values use an annualization factor of 320 days per year. Auto person trips values use an annualization factor of 315 days per year.

DRAFT – final values in development, numbers may vary

Projections for Changes in Total Emissions

- Auto emissions are reduced across alternatives, but are offset by increased train emissions in some alternatives and/or for some emission types

Annual Emissions* Compared to No-Build	Alternative 1: Higher Frequency Commuter Rail	Alternative 2: Regional Rail to Key Stations (Diesel)	Alternative 3: Regional Rail to Key Stations (Electric)	Alternative 4: Urban Rail (Diesel)	Alternative 5: Urban Rail (Electric)	Alternative 6: Full Transformation
Change in Annual Nitrogen Oxides (NOx) Emissions	↑	↑	↓	↑	↓	↓
Change in Annual Carbon Monoxide (CO) Emissions	↓	↓	↓	↓	↓	↓
Change in Annual Carbon Dioxide (CO_2) Emissions	↑	↑	↓	↑	↓	↓
Change in Annual Particulate Matter (PM) Emissions	↔	↑	↑	↑	↑	↑

Notes: Nitrogen oxides (NOx) are produced when combustion temperatures are extremely high. Of nitrogen oxides, nitric oxide (NO) and nitrogen dioxide (NO_2) are the most significant air pollutants. Nitrogen dioxide has been found to be a lung irritant and can lead to respiratory illnesses. Carbon monoxide (CO) is a colorless and odorless gas that is a product of incomplete combustion and can be absorbed by the lungs, reducing the oxygen carrying capacity of the blood and leading to other health complications. Carbon dioxide (CO_2) is the predominant contributor to global warming. Particulate matter (PM) is made up of small solid particles and liquid droplets, and can enter the body through the respiratory system.
Annualization factors provided by CTPS. Auto emission rates are from MOVES 2014b. Emissions rates for electric trains calculated with 2017 ISO New England LMU marginal emissions rates, and 2016 EPA eGRID rates for Massachusetts.

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Environmental Justice Analysis

- CTPS completed an Environmental Justice (EJ) analysis for all alternatives, looking at impact of each alternative on minority and low-income populations for:
  - Accessibility – Access to jobs, retail opportunities, and higher education by transit
  - Mobility – Average transit and highway travel times
  - Environmental – Congested VMT and CO emissions
- **EJ populations receive benefits in all alternatives**

Benefits to EJ Populations	**Alternative 1:** Higher Frequency Commuter Rail	**Alternative 2:** Regional Rail to Key Stations (Diesel)	**Alternative 3:** Regional Rail to Key Stations (Electric)	**Alternative 4:** Urban Rail (Diesel)	**Alternative 5:** Urban Rail (Electric)	**Alternative 6:** Full Transformation
Accessibility	✓	✓	✓	✓	✓	✓
Mobility	✓	✓	✓	✓	✓	✓
Environmental	✓	✓	✓	✓	✓	✓

Next Steps

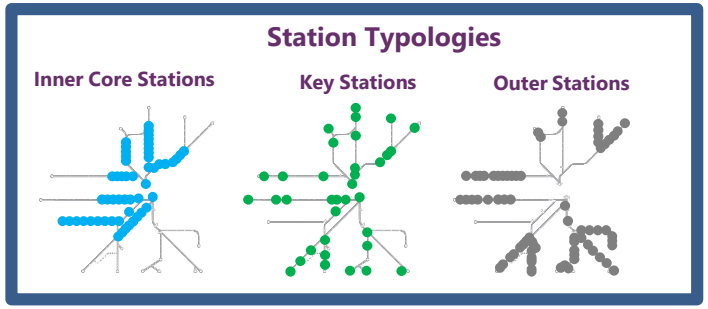
Next Steps – Advancing the Rail Vision

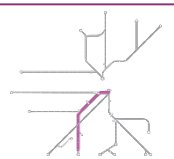
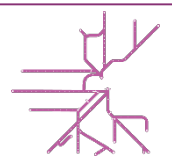
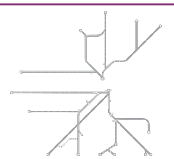
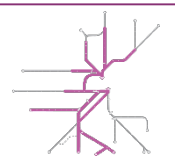
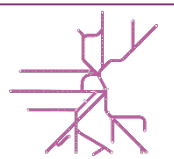
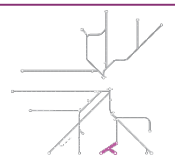
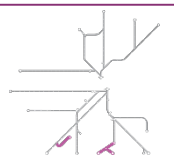
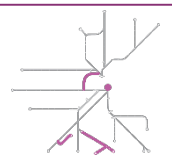
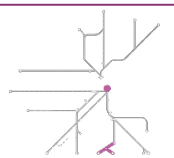
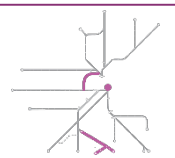
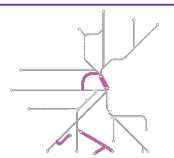
- Public Meeting – October 23
- Joint FMCB + Rail Vision Advisory Committee Meeting – October 28
- FMCB Next Steps Discussion – November

Public Comment

RAIL VISION

Review of Alternatives



	1: Higher Frequency Commuter Rail	2: Regional Rail to Key Stations (Diesel)	3. Regional Rail to Key Stations (Electric)	4: Urban Rail (Diesel)	5. Urban Rail (Electric)	6. Full Transformation
Typical Frequency (Peak/Off-Peak)						
Key Stations	30/60	15/15 (North Side) 30/30 (South Side)	15/15	30/60	30/60	15/15
Inner Core	30/60	30/60	30/60	15/15	15/15	15/15
Outer Stations	30/60	30/60	30/60	30/60	30/60	15/15
Fully Accessible High-Level Platforms						
Key Stations	Existing or Programmed Upgrades Only	✓	✓	-	-	✓
Inner Core		-	-	✓	✓	✓
Outer Stations		-	-	-	-	✓
Parking Modeled as Unconstrained						
Most Key Stations	Parking Modeled Fully Constrained	✓	✓	-	-	✓
Urban Rail Termini		-	-	✓	✓	✓
Non-Rapid Transit Stations with >50 Spaces		-	-	-	-	✓
Electrification						
Major Expansions						

Evaluating relative benefits and costs across the alternatives will provide the foundation to build one or more Visions for the future of commuter rail, which may combine features from multiple alternatives to maximize the effectiveness of the MBTA rail network.

Note: All text and maps describe a typical application at the system level but may vary to some extent at the line, station, or segment levels. Parking constraints defined on ridership slides for each alternative.

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