

# RAIL VISION

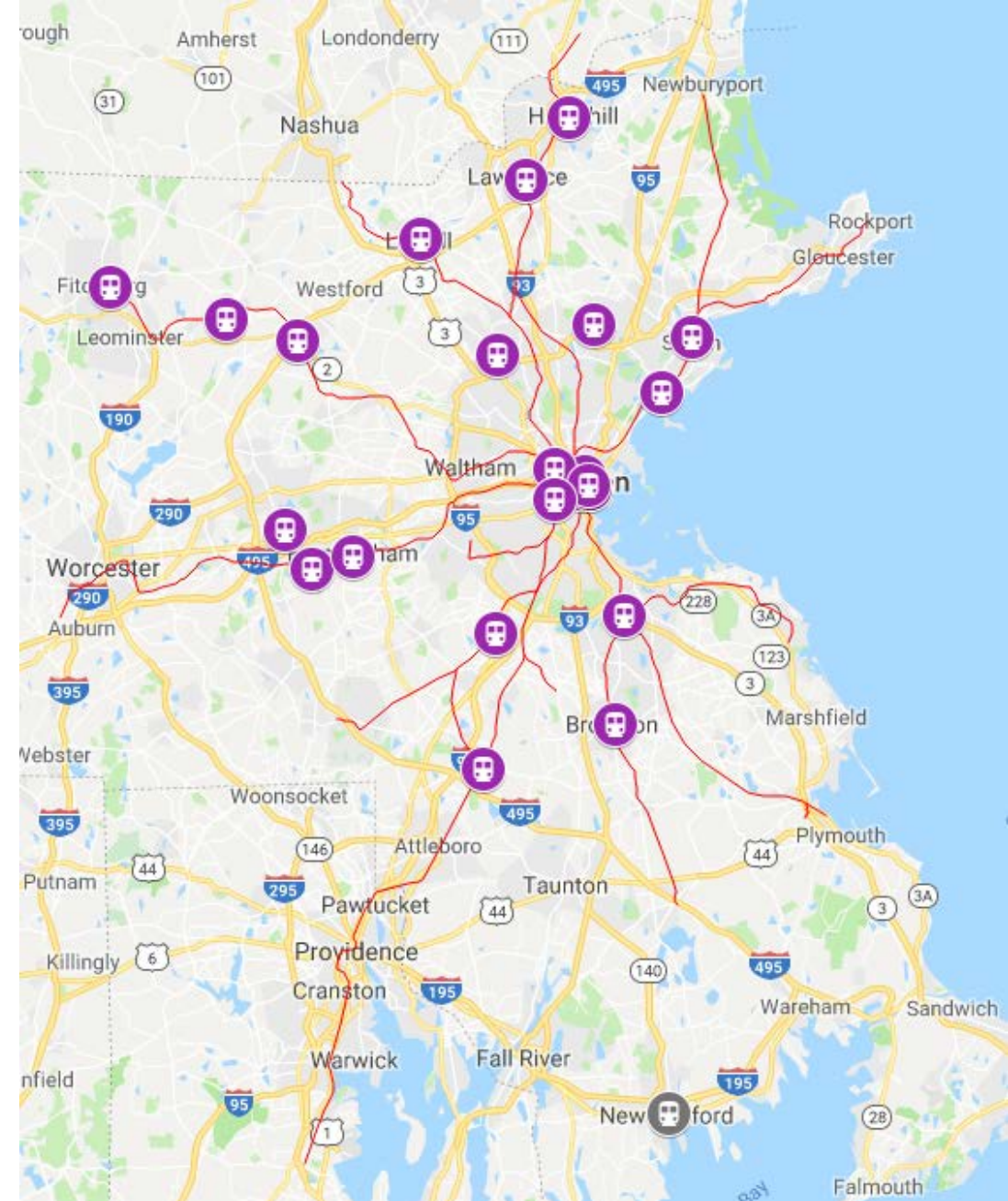


## FMCB Meeting Presentation

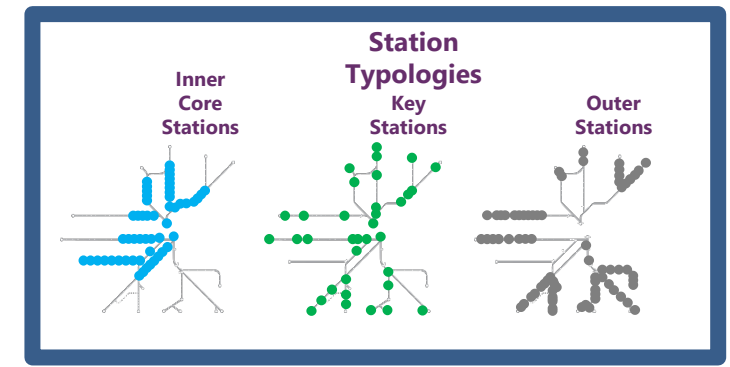
JULY 22, 2019

# Stakeholder Engagement


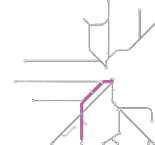

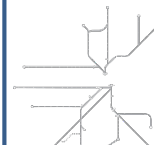
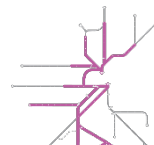

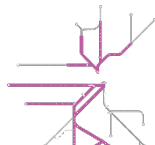
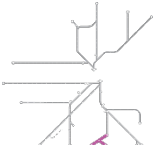
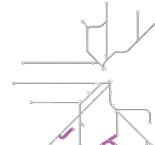


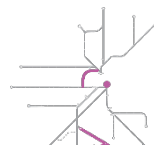
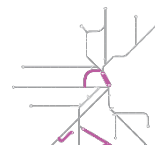
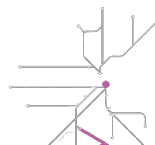
- Peer Reviews
- Advisory Committee (6 meetings + optional)
- Public Meeting and Open House
- State House/Legislative Briefing (2)
- Briefings/Meetings throughout the region (40, to date)
- Non-Rider Survey focused on trade-offs gathered nearly 3,000 responses



# Comparing Alternatives



Evaluating relative benefits and costs across the seven 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.

	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	7: Hybrid System
<b>Typical Frequency (Peak/Off-Peak)</b>							
Key Stations	● 30/60	● 15/15 (North Side) ● 30/30 (South Side)	● 15/15	● 30/60	● 30/60	● 15/15	● 30/60
Inner Core	● 30/60	● 30/60	● 30/60	● 15/15	● 15/15	● 15/15	● 15/30
Outer Stations	● 30/60	● 30/60	● 30/60	● 30/60	● 30/60	● 15/30	● 30/60
<b>Fully Accessible High-Level Platforms</b>							
Key Stations		✓	✓	-	-	✓	✓
Inner Core	Existing or Programmed Upgrades Only	-	-	✓	✓	✓	✓
Outer Stations		-	-	-	-	✓	-
<b>Electrification</b>							
<b>Major Expansions</b>							

## Today's Results and Project Objectives and Metrics

<i><b>Project Objective</b></i>	<i><b>Metrics</b></i>
Match service with the growing and changing needs of the region	<b>Ridership</b> Connectivity (job access)
Enhance economic vitality	Connectivity (job access)
Improve the passenger experience	<b>Frequency</b> Travel Time Savings
Provide an equitable and balanced suite of investments	Equity
Help the Commonwealth achieve its climate change sustainability targets	<b>Ridership</b> Greenhouse Gas Emissions Reductions
Maximize return on investment (financial stewardship)	<b>Capital Costs</b> <b>Operating Costs</b>

## Methodology – No-Build Demand (2040)

- Modeled using CTPS regional travel demand model for 2040 Future Year using MAPC projected land use
- Assumes current fare structure
- Alternatives are compared to a 2040 No-Build Scenario
  - **No-Build is demand, not ridership. It does not constrain boardings to available seats, but does constrain to current parking supply** and assumes existing MBTA services and expansions from financially constrained plans (e.g., SCR Phase 1)
- Systemwide commuter rail demand increases in all alternatives
- Other modes are impacted by increased commuter rail service (diversions, connectivity), so demand increases by 12% (157,400 boardings)

## General Findings – No-Build Demand (2040)

No-Build Results	Total 2040 No-Build Daily Boardings	Increase in Daily Boardings (2018 – 2040)	% Increase in Daily Boardings (2018 – 2040)	Findings on Growth
Commuter Rail	150,800	24,000	19%	Growth without Rail Vision in place by 2040
North Side	46,100	3,800	9%	Highest on Haverhill and Lowell Lines
South Side	104,700	20,200	24%	Highest on Old Colony Lines and SCR
Other Modes	1,500,500	157,400	12%	Highest on Rapid Transit and Silver Line

## General Findings and Methodology – Order-of-Magnitude (OOM) Capital Costs

- Presented in 2020\$ and 2030\$
  - Unit costs obtained from similar MBTA and peer agency projects
  - Fleet unit costs based on market conditions and industry comparisons, and includes ancillary costs such as spare parts and training
  - Major expansion costs (e.g., SSX, NSRL) based on previous work
  - Real estate impacts accounted for to the extent practicable (i.e., major takings)
  - Contingencies and soft costs applied consistent with MBTA project controls
- Fleet, and associated layover/maintenance, and electrification found to be the largest capital costs
- Initial needs were **not designed or engineered** and do not account for life cycle costs

## General Findings and Methodology - Fleet and Consist Sizing

- Fleet sizes (number of vehicles) are calculated based on service plans needs, based on the following:
  - Consist sizes (lengths of trains) are based on CTPS ridership estimates
  - Estimates provided may change based on period and direction ridership data and associated consist sizing
- Fleet Estimates for Costs Estimates
  - Current Approach - Estimate incremental fleet or new vehicle types needed beyond today's MBTA diesel fleet
  - Potential Variations to Fleet Estimates
    - Assume fully new fleet for all alternatives
    - Identify a "credit" for current and future MBTA investments



## General Findings and Methodology – Operating and Maintenance (O&M) Costs

- Presented in 2020\$
  - Presented as increase over baseline costs and annualized
  - Grounded in existing cost data from the MBTA commuter rail
  - Peer US commuter rail system data used for:
    - Electric locomotives and EMUs
    - Electric transmission system (catenary, etc.) costs
    - DMUs
  - Uses operational and ridership outputs from each alternative as inputs into the model
  - Costs are not offset by revenue (e.g. fares, parking fees, other)
- All alternatives increase operating costs
  - Increase in service levels drives increase in operating costs

# Comparison of Alternatives – Key Characteristics

	<b>Alternative 1: Higher Frequency Commuter Rail</b>	<b>Alternative 2: Regional Rail to Key Stations (Diesel)</b>	<b>Alternative 3: Regional Rail to Key Stations (Electric)</b>
Objective	<b>Predictable, bi-directional</b> service with modest investments in infrastructure	Greatly improves service to select <b>high-density areas outside the core</b>	Greatly improves service to select <b>high-density areas outside the core with EMUs</b>
Typical Frequency (Peak min/Off-Peak min Headway)	All Stations: <b>30/60</b> bi-directional	Key Stations (North Side): <b>15/15</b> bi-directional Key Stations (South Side): <b>30/30</b> bi-directional All Other Stations: <b>30/60</b> bi-directional	Key Stations: <b>15/15</b> bi-directional All Other Stations: <b>30/60</b> bi-directional
Station Accessibility	High-level boarding platforms at stations where they are <b>currently existing or programmed</b>	<b>All Key Stations</b> would have high-level boarding platforms	<b>All Key Stations</b> would have high-level boarding platforms
Electrification	None	Service between Boston and Providence would be electrified	The full system would be <b>electrified</b>
Train Type(s)	Diesel Locomotives	Diesel Locomotives Electric Locomotives (to Providence)	Electric Multiple Units (EMUs)
Major Expansions	South Coast Rail Phase 1	South Coast Rail Phase 1 Foxboro	South Station Expansion South Coast Rail Full Build Grand Junction (Shuttle) Foxboro

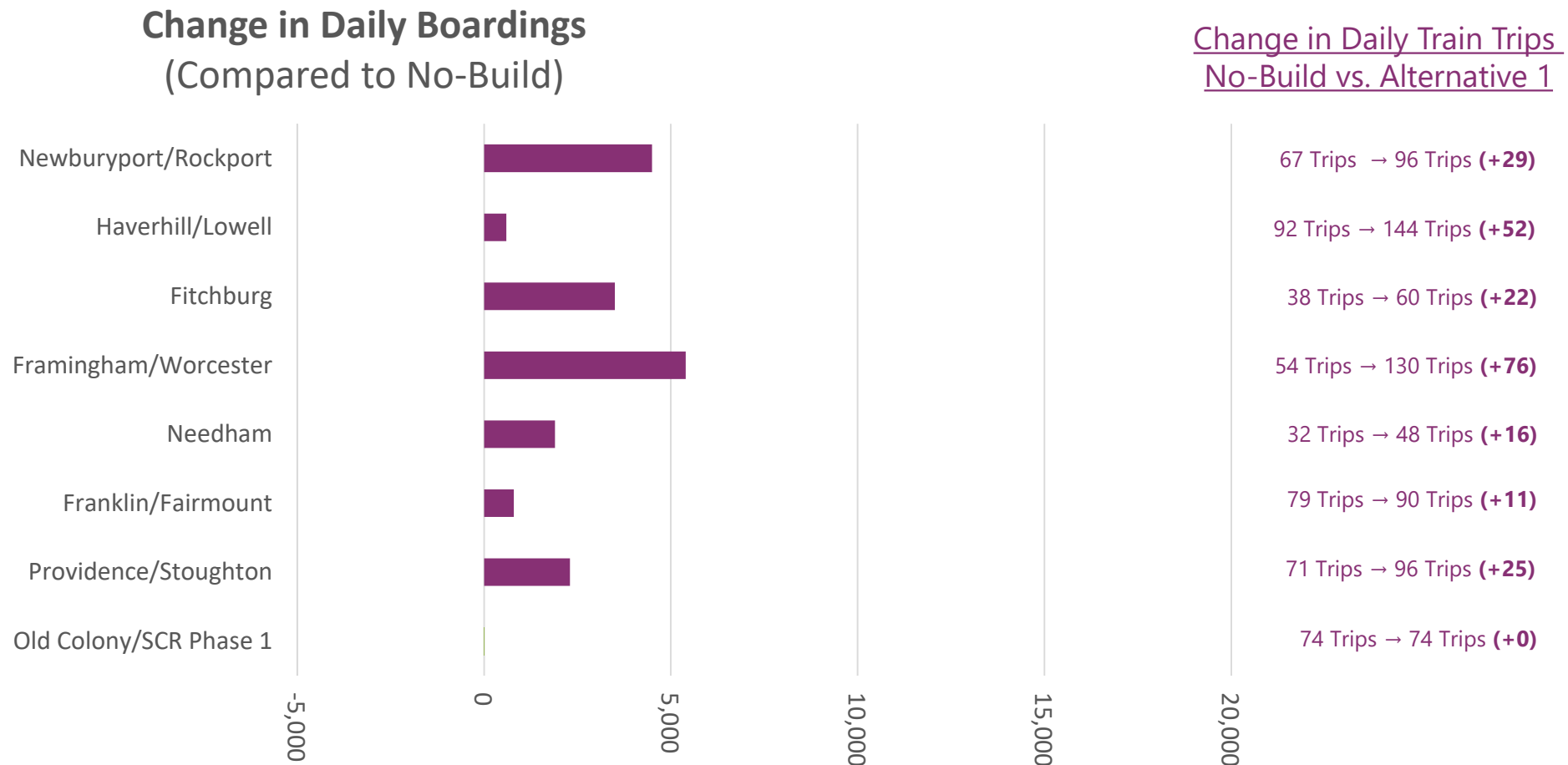
## Alternative 1: Higher Frequency Commuter Rail – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- **Assumes current fares**

Alternative 1	Increase in Daily Boardings over No-Build Demand	% Increase in Daily Boardings over No-Build Demand	Findings on Growth
Commuter Rail	19,000	13%	Overall growth
North Side	8,600	19%	Highest on Newburyport/Rockport and Fitchburg Lines
South Side	10,400	10%	Highest on Framingham/ Worcester Line; <b>Old Colony/SCR service pattern does not change in Alternative 1</b>
Other Modes	6,000	<1%	Increases on Green, Red, Silver Lines; Blue Line and bus reductions/diversions

# Alternative 1: Higher Frequency Commuter Rail – Preliminary Ridership (2040)

- Ridership increases vary by line

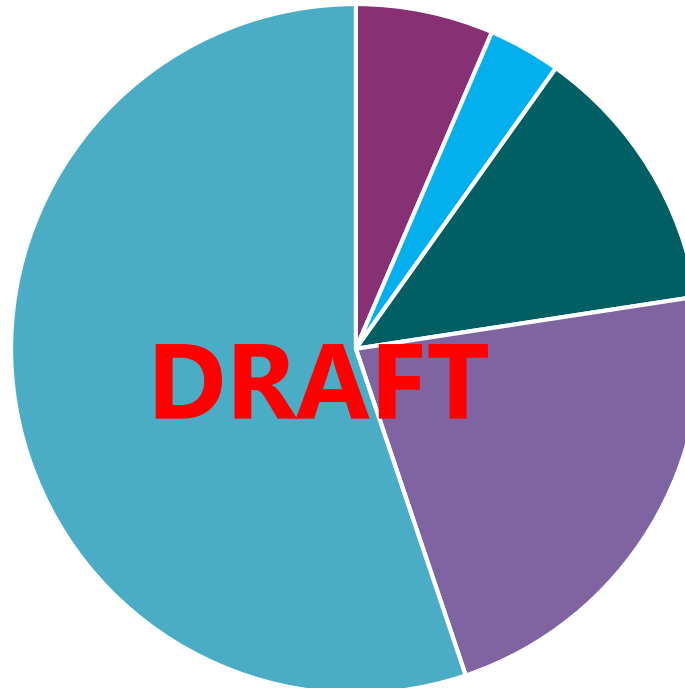


# Alternative 1: Higher Frequency Commuter Rail - Preliminary Capital Costs

## Order-of-Magnitude Capital Costs (2020\$/2030\$)

\$2.2B (2020\$)/\$3.1B (2030\$)  
(Expand Existing Fleet)

Fleet costs are based on incremental fleet for diesel options

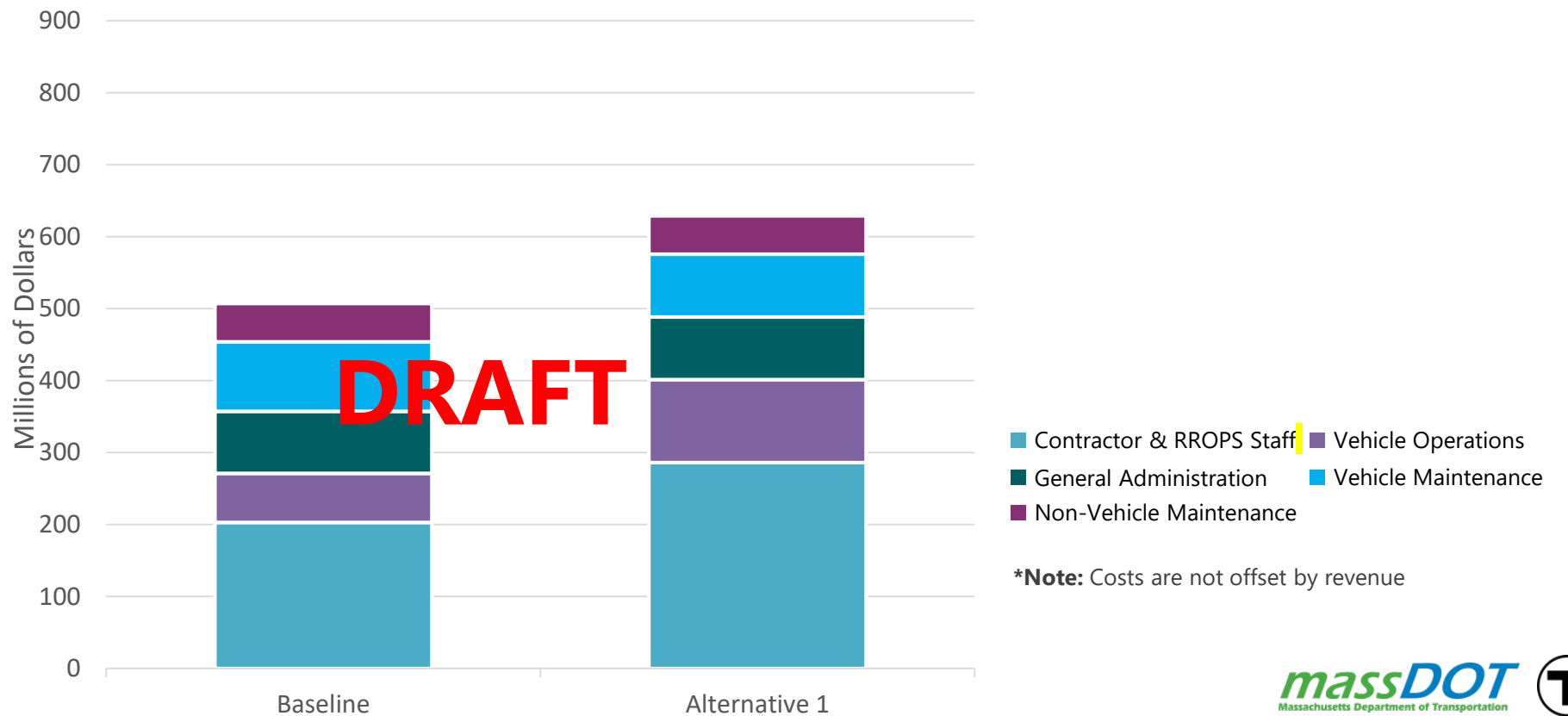


- Fleet Procurement
- Layover and Maintenance Facilities
- Stations
- Track and Signal Work
- Structures

# Alternative 1: Higher Frequency Commuter Rail - Preliminary Operations and Maintenance Costs

## Annual O&M Costs\* (2020\$)

Increase of \$122M/Year



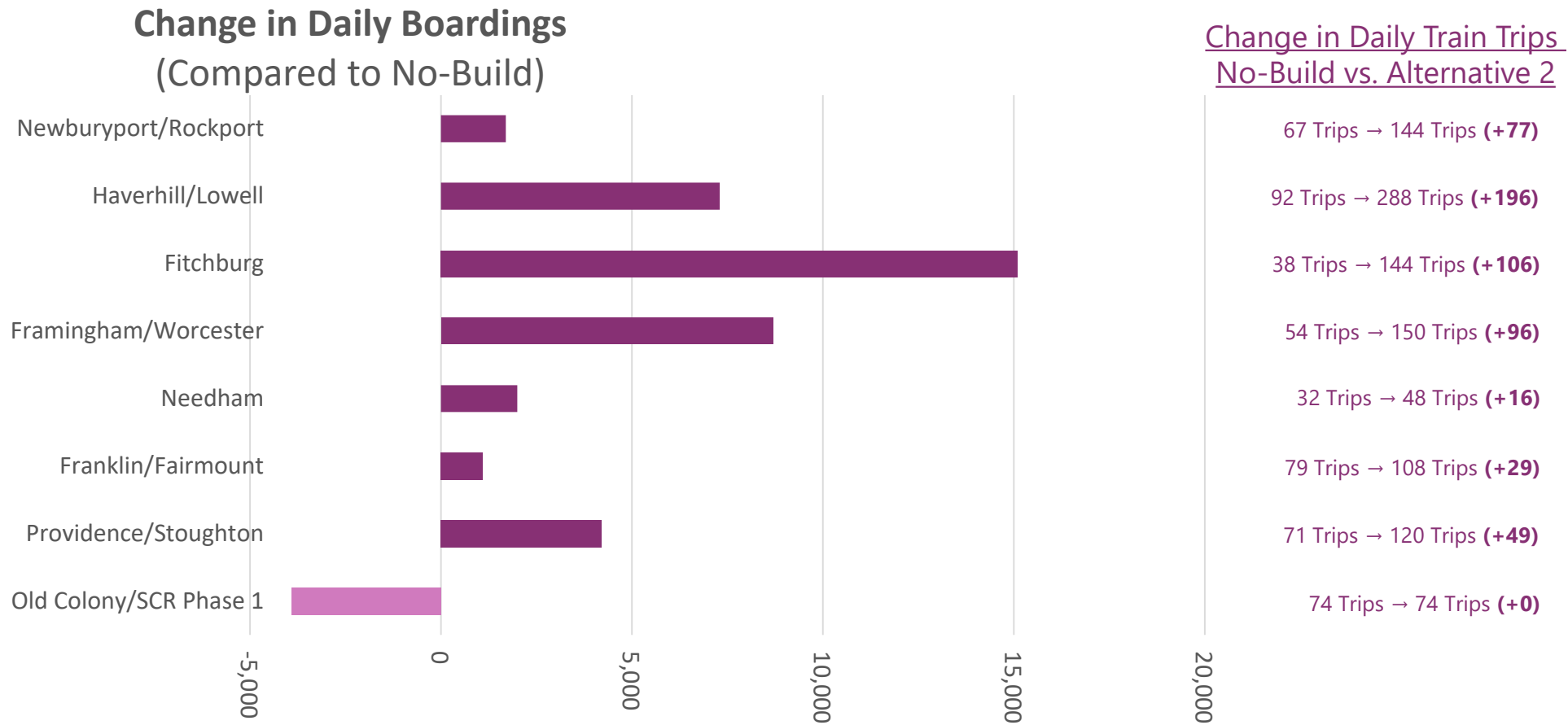
## Alternative 2: Regional Rail to Key Stations (Diesel) – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- **Assumes current fares; unconstrained parking at Key Stations**

Alternative 1	Increase in Daily Boardings over No-Build Demand	% Increase in Daily Boardings over No-Build Demand	Findings on Growth
Commuter Rail	36,200	24%	Growth primarily on North Side due to less frequency on South Side (terminal capacity limitations)
North Side	24,100	52%	Highest on Fitchburg and Haverhill/Lowell Lines
South Side	12,100	12%	<b>Less growth than North Side as alternative does not reach target 15-min all-day frequency</b> Reductions on Old Colony lines due to diversions to unconstrained parking (e.g., Red Line/Braintree)
Other Modes	40,500	3%	Highest on Red Line, Green Line; Local bus reductions/diversions

## Alternative 2: Regional Rail to Key Stations (Diesel) – Preliminary Ridership (2040)

- Ridership increases vary by line; South Side growth lower than North Side likely due to receiving less frequency (30-min all-day) than North Side (15-min all-day)
- Reductions on Old Colony lines due to diversions to unconstrained parking (e.g., Red Line/Braintree)





## Alternative 2: Regional Rail to Key Stations (Diesel)- Preliminary Capital Costs

### Order-of-Magnitude Capital Costs (2020\$/2030\$)

\$5.3B (2020\$)/\$7.5B (2030\$)  
(Expand Existing Fleet)

Fleet costs are based on incremental fleet for diesel options

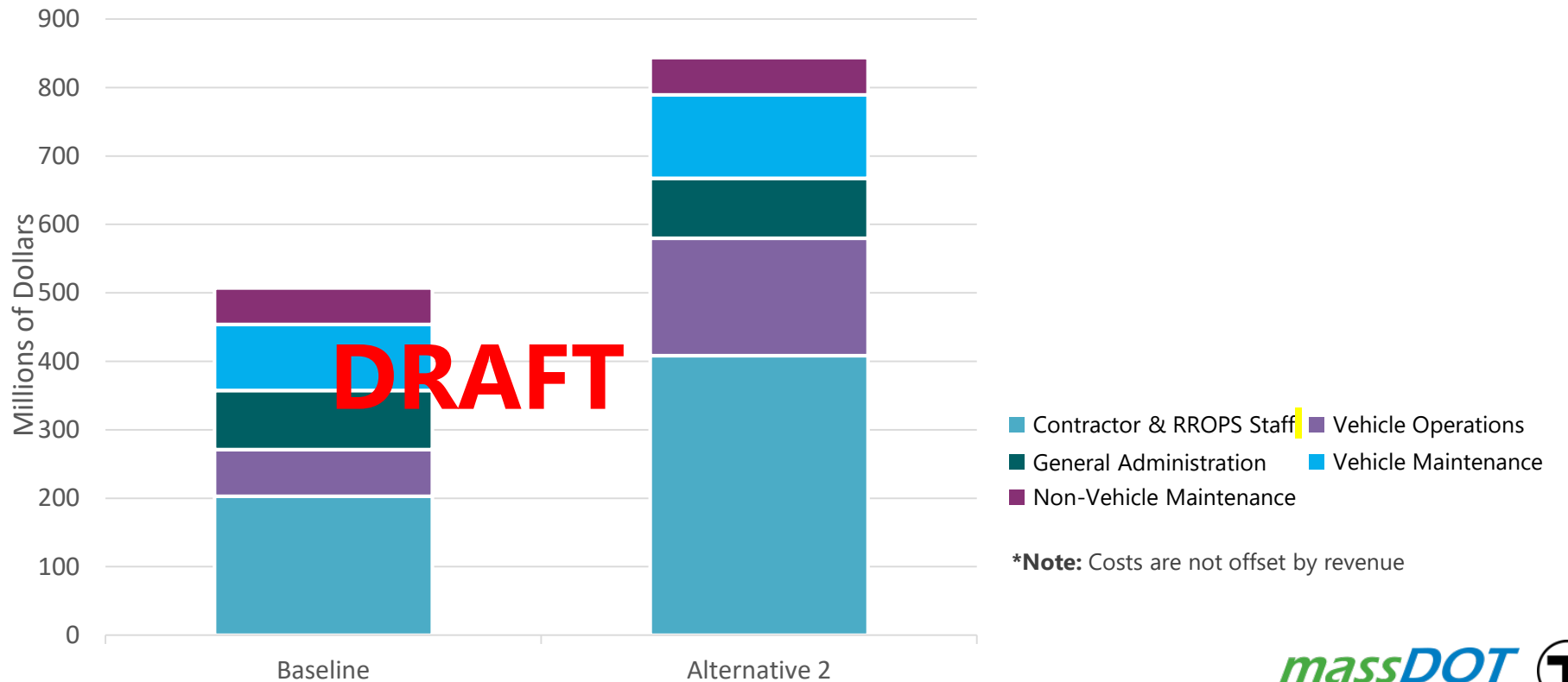


- Fleet Procurement
- Layover and Maintenance Facilities
- Stations
- Structures
- Track and Signal Work

# Alternative 2: Regional Rail to Key Stations (Diesel)- Preliminary Operations and Maintenance Costs

## Annual O&M Costs\* (2020\$)

Increase of \$337M/Year



## Alternative 3: Regional Rail to Key Stations (Electric) – Preliminary Ridership (2040)

- Daily boardings compared against 2040 No-Build Demand
- **Assumes current fares; unconstrained parking at Key Stations**

Alternative 1	Increase in Daily Boardings over No-Build Demand	% Increase in Daily Boardings over No-Build Demand	Findings on Growth
Commuter Rail	52,900	35%	SSX allows for more south side growth than in Alternative 2; Some ridership growth from electrification
North Side	28,500	62%	Highest on Fitchburg and Haverhill/Lowell Lines
South Side	24,400	23%	Highest on Framingham/ Worcester Line and Providence/SCR Full Build; <b>Reductions on Old Colony Lines due to interlining (Kingston/Greenbush) and diversions to unconstrained parking (e.g., Red Line/Braintree)</b>
Other Modes	47,900	3%	Highest on Red Line, Orange Line, Green Line; MBTA local bus reductions/diversions

## Alternative 3: Regional Rail to Key Stations (Electric) – Preliminary Ridership (2040)

- Ridership increases vary by line; Reductions on Old Colony Lines due to interlining (Kingston/Greenbush) and diversions to unconstrained parking (e.g., Red Line/Braintree)

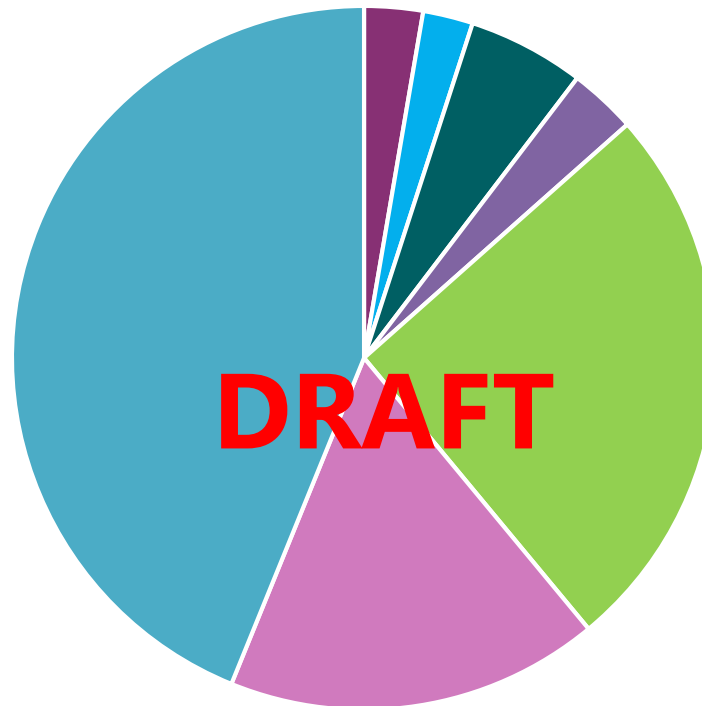


### Alternative 3: Regional Rail to Key Stations (Electric) – Preliminary Capital Costs

#### Order-of-Magnitude Capital Costs (2020\$/2030\$)

\$23.6B (2020\$)/\$33.3B (2030\$)  
(includes Expansions)

Fleet costs are based on need for entire new electric fleet

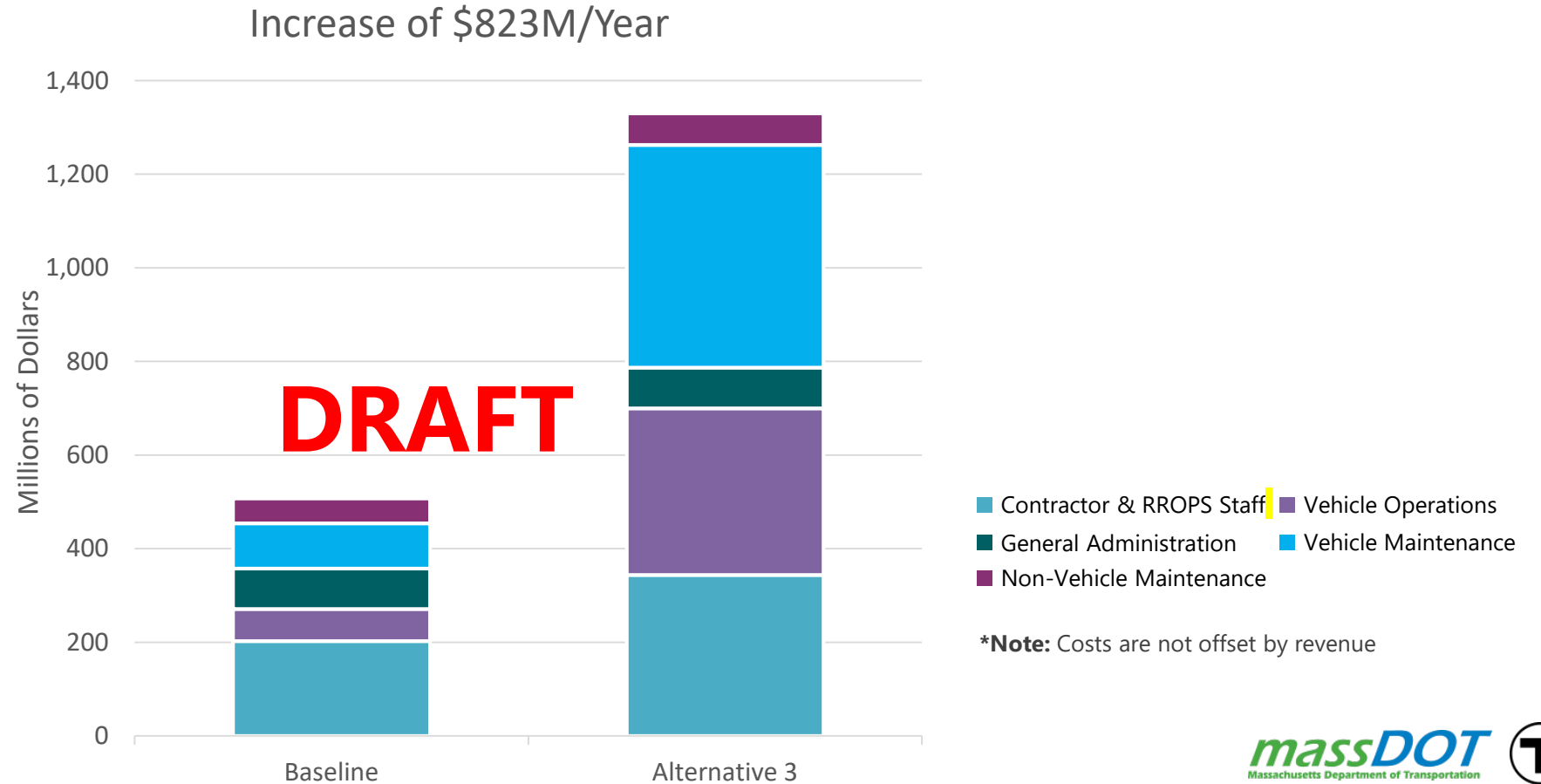


Expansions include SSX, Grand Junction, Old Colony Braintree to South Station Double Track, and modified North Station, and excludes SCR Full Build and Foxboro

- Fleet Procurement
- Electrification
- Stations
- Track and Signal Work
- Expansions
- Layover and Maintenance Facilities
- Structures

## Alternative 3: Regional Rail to Key Stations (Electric) – Preliminary Costs

### Annual O&M Costs (2020\$)



# South Station Expansion Needed for Target Frequencies

- An expanded station with **more platforms and tracks** is necessary to deliver **higher levels of frequency** to South Side lines, due to capacity constraints with current station.
- The team tested Regional Rail without South Station Expansion (SSX) by adjusting the frequency to South Side Key Stations to 30-minutes all-day in Alternative 2. Alternative 3 includes SSX and achieves 15-minute all-day frequency for most South Side Key Stations using an electrified service.
- The projected South Side ridership growth of 24,400 daily boardings in Alternative 3 illustrates the total effect of electrification, increased frequency enabled by SSX, and other factors.

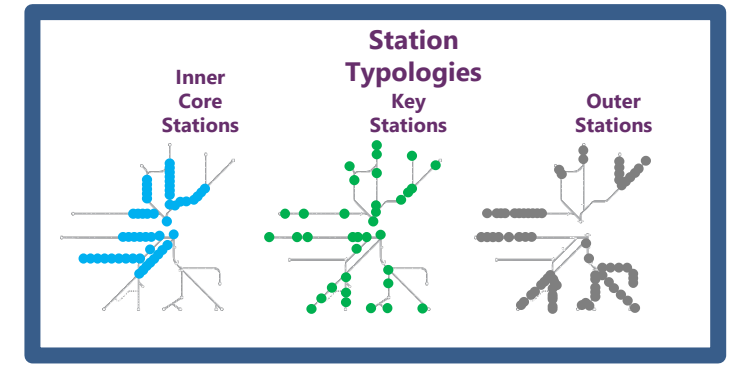
	North Side Growth	South Side Growth	
Alternative 1	8,600 (19%)	10,400 (10%)	<i>Assessing the ridership difference in North Side service between Alternatives 1, 2, and 3 provides insight into the individual effects of increased frequency and electrification on ridership. <b><u>The largest increase in North Side ridership occurs when shifting from Alternative 1 to Alternative 2, implying that frequency accounts for more ridership growth than electrification.</u></b></i>
Alternative 2	24,100 (52%)	12,100 (12%)	
Alternative 3	28,500 (62%)	24,400 (23%)	

# Comparison of Alternatives – Preliminary Results


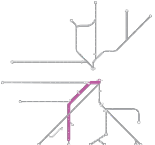
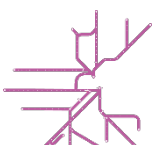
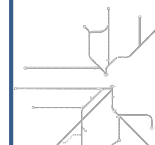


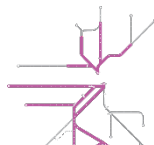
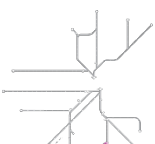
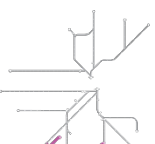
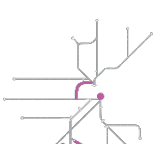


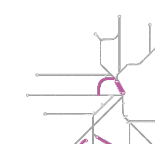
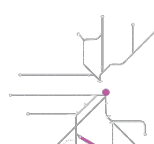
	Alternative 1: Higher Frequency Commuter Rail	Alternative 2: Regional Rail to Key Stations (Diesel)	Alternative 3: Regional Rail to Key Stations (Electric)
2040 Ridership (compared to No-Build)	Increase of <b>19,000</b> daily boardings ( <b>13%</b> ) on Commuter Rail <ul style="list-style-type: none"> <li>• North Side: <b>8,600 (19%)</b></li> <li>• South Side: <b>10,400 (10%)</b></li> </ul> <b>9,200</b> new transit trips systemwide	Increase of <b>36,200</b> daily boardings ( <b>24%</b> ) on Commuter Rail <ul style="list-style-type: none"> <li>• North Side: <b>24,100 (52%)</b></li> <li>• South Side: <b>12,100 (12%)</b></li> </ul> <b>21,200</b> new transit trips systemwide	Increase of <b>52,900</b> daily boardings ( <b>35%</b> ) on Commuter Rail <ul style="list-style-type: none"> <li>• North Side: <b>28,500 (62%)</b></li> <li>• South Side: <b>24,400 (23%)</b></li> </ul> <b>35,800</b> new transit trips systemwide
Capital Needs	Minimal	Moderate	Significant
Fleet Needs	Diesel Locomotives Bi-Level Cab Cars Bi-Level Coaches	Diesel Locomotives Electric Locomotives Bi-Level Cab Cars Bi-Level Coaches	EMUs
OOM Capital Costs (2020\$/ 2030\$)	<b>\$2.2B (2020\$)/\$3.1B (2030\$)</b>	<b>\$5.3B (2020\$)/\$7.5B(2030\$)</b>	<b>\$23.6B (2020\$)/\$33.3B(2030\$)</b>
Annualized O&M Costs (2020\$) Increase/Year	<b>\$122M/year</b>	<b>\$337M/year</b>	<b>\$823M/year</b>
Key Takeaways	Longer Lines get more express services (Worcester, Fitchburg, Haverhill)  Frequency increases seen primarily in off-peak period and reverse peak directions	Improves on today's frequency for some lines, even for stations not defined as Key Stations  Significant increases on other modes from diversions and connectivity  Existing terminal capacity constraints limit the ability to expand service	Reduces emissions while providing lower travel times and fewer operating conflicts between different service types  Significant increases on other modes from diversions and connectivity  Benefits of terminal capacity are seen



# Looking Ahead: Alternatives 4 – 7



Evaluating relative benefits and costs across the seven 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.

	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	7: Hybrid System
<b>Typical Frequency (Peak/Off-Peak)</b>							
Key Stations	● 30/60	● 15/15 (North Side) ● 30/30 (South Side)	● 15/15	● 30/60	● 30/60	● 15/15	● 30/60
Inner Core	● 30/60	● 30/60	● 30/60	● 15/15	● 15/15	● 15/15	● 15/30
Outer Stations	● 30/60	● 30/60	● 30/60	● 30/60	● 30/60	● 15/30	● 30/60
<b>Fully Accessible High-Level Platforms</b>							
Key Stations		✓	✓	-	-	✓	✓
Inner Core	Existing or Programmed Upgrades Only	-	-	✓	✓	✓	✓
Outer Stations		-	-	-	-	✓	-
<b>Electrification</b>							
<b>Major Expansions</b>							

## Seeking Your Feedback

1. How should we consider the costs of fleets as we assess results?
2. We are not including costs for investments already programmed through the five year financially constrained Capital Investment Program. What, if any, assumptions should be made about other capital costs (station upgrades, double tracking, etc.) the MBTA may incur on the rail system over the Rail Vision planning horizon?
3. How should we display estimated O&M costs, considering the variation across alternatives in the number of train trips and technologies used?

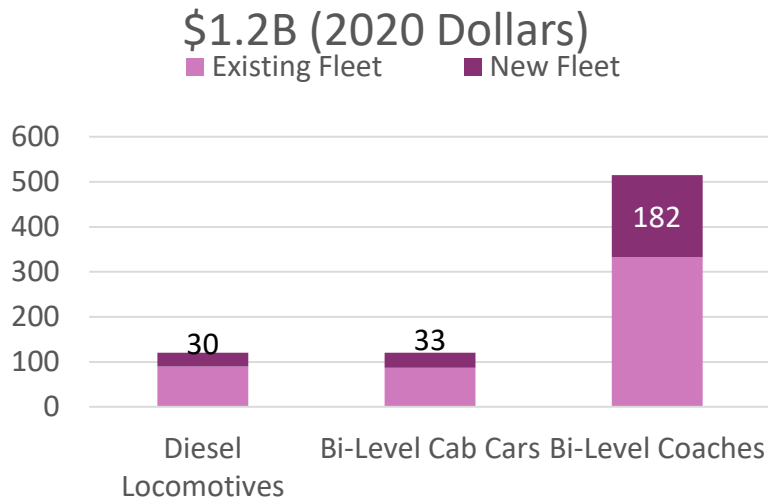
## Next Steps

- Upcoming Meetings
  - Advisory Committee: Results for Alternatives 4, 5, 6, and 7 – September 12
  - Joint MassDOT/FMCB Meeting – July 22 and September 16
  - Metrolinx “Lessons Learned” – September 23
- Additional Modeling to Support Findings
  - Ridership – emissions, VMT, etc.
  - Land Use
- Implementation Plan Development

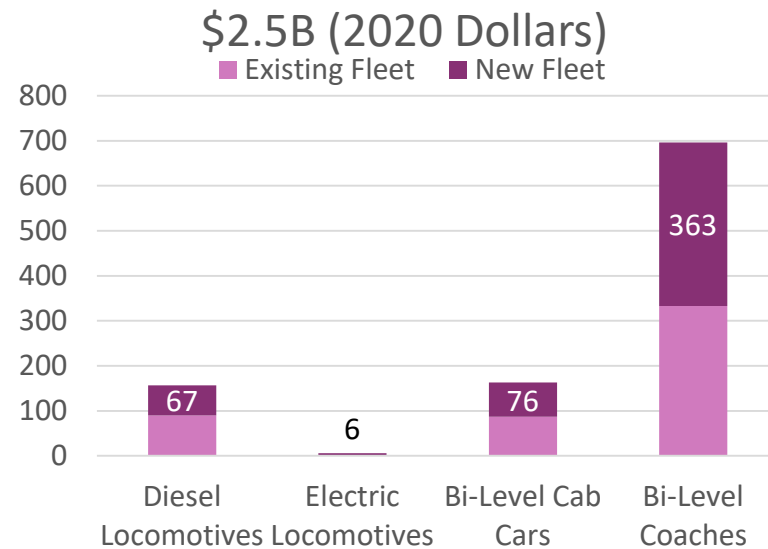
# Appendix

# Fleet Estimate (Current Approach): Estimate Incremental and/or New Fleet Growth

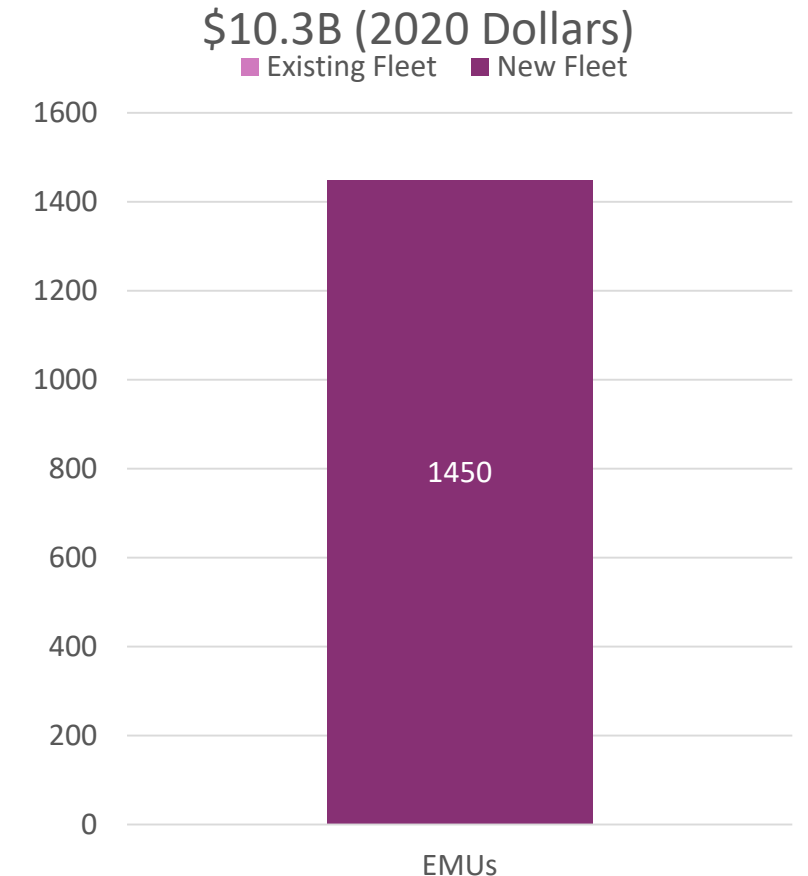
**Alternative 1: Higher Frequency Commuter Rail**



**Alternative 2: Regional Rail to Key Stations (Diesel)**

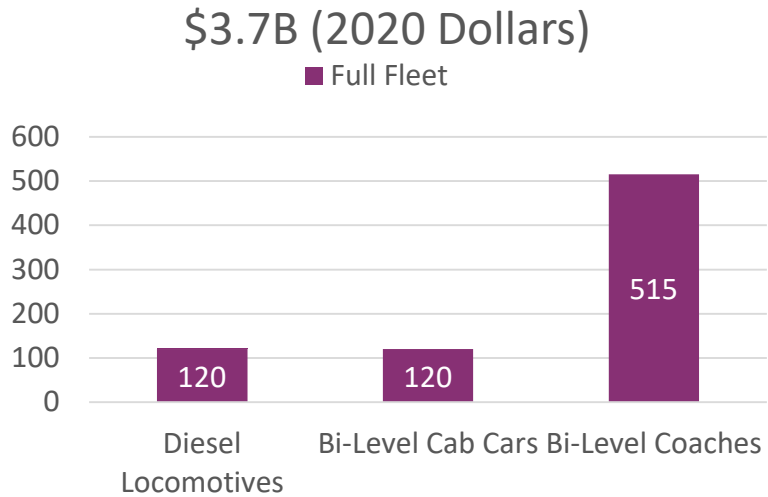


**Alternative 3: Regional Rail to Key Stations (Electric)**

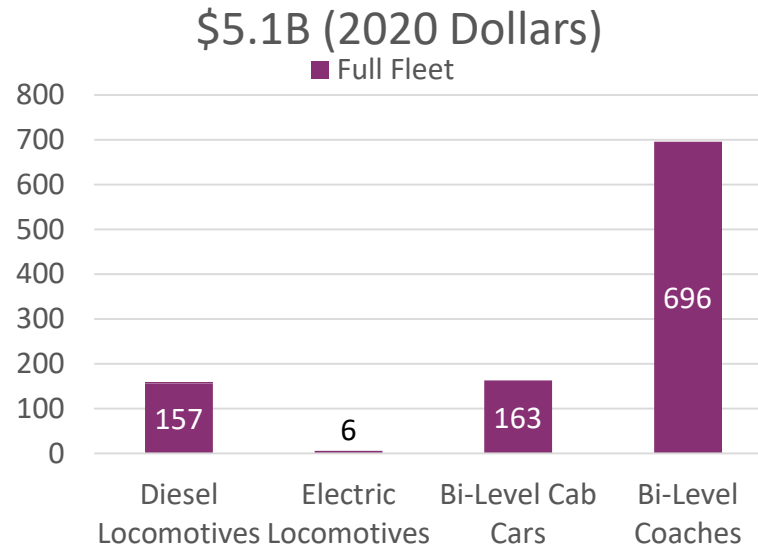


## Potential Variation: Assume Full New Fleet

**Alternative 1:** Higher Frequency Commuter Rail



**Alternative 2:** Regional Rail to Key Stations (Diesel)



**Alternative 3:** Regional Rail to Key Stations (Electric)

