Massachusetts Bay Transportation Authority

Regional Rail Transformation Update

Traction Power Planning for Regional and Urban Rail Services

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Summary

- Introduction
- Electrification Approach
  - Catenary Challenges
  - Discontinuous concept
  - Benefits & Potential Risks
  - Future Fleet Procurement
- No Regrets Projects
  - Urban Rail first steps
  - Current CIP projects & planning
- Appendix

Regional Rail Transformation

- The MBTA remains strongly committed to Regional Rail Transformation
- First steps in Spring 2021 service
  - All day bi-directional service on all lines
  - At least hourly Clock face service on 8 lines/branches
  - Planning projects to bring remaining 4 branches to hourly
- Phase one of electrification defined by the FMCB as:
  - Providence/Stoughton Line,
  - Fairmount Line
  - Environmental Justice corridor of the Newburyport/Rockport Line
- Rail Vision was in 2019 and times have changed
  - Demand will be different
  - Emissions are worse
- Investigating battery mixed with Catenary sections to reduce cost and accelerate delivery

Phase One

Electrification Approach

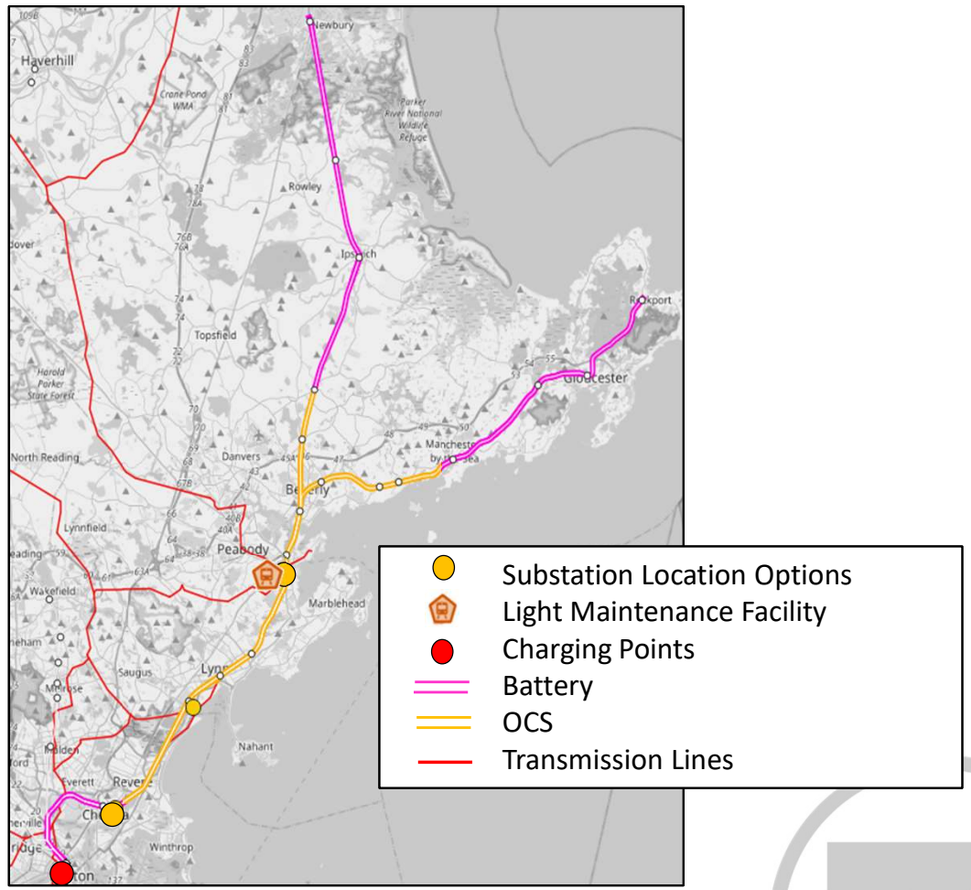
Electrification Challenges

- Requires lengthy Environmental process for 331 route miles of Catenary
  - Amtrak North end electrification approval in 1995 took 3 years and was part of a program from 1978
- Power Grid is poor in some remote points
  - Currently need backup generators in the summer in Rockport
  - Nearest High Voltage line to Newburyport is 6 miles away
- Slow and expensive to install Catenary in tunnels and over draw bridges
- Significant vertical clearance issues especially in downtown Boston under buildings

Discontinuous Electrification Concept

- Discontinuous electrification is the use of overhead catenary to charge battery-electric trains while moving so they can travel off-wire
- Initial use was for low bridges and tunnels which could not be modified
- Concept grew as battery technology evolved to serve short branch lines off electrified main lines
- Uses existing electrification technology for charging unlike battery only which needs special high current fast charging points

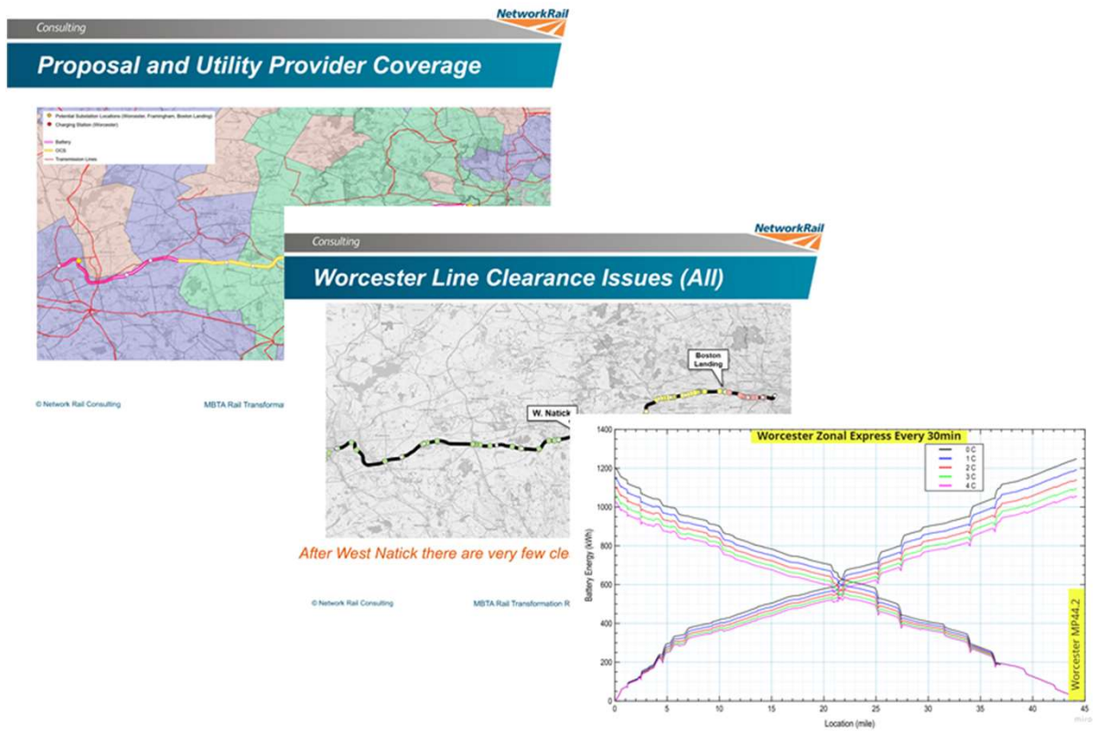
By modeling power needs now, we can reduce mileage of OCS and skip costly sections using battery



Discontinuous Electrification Analysis

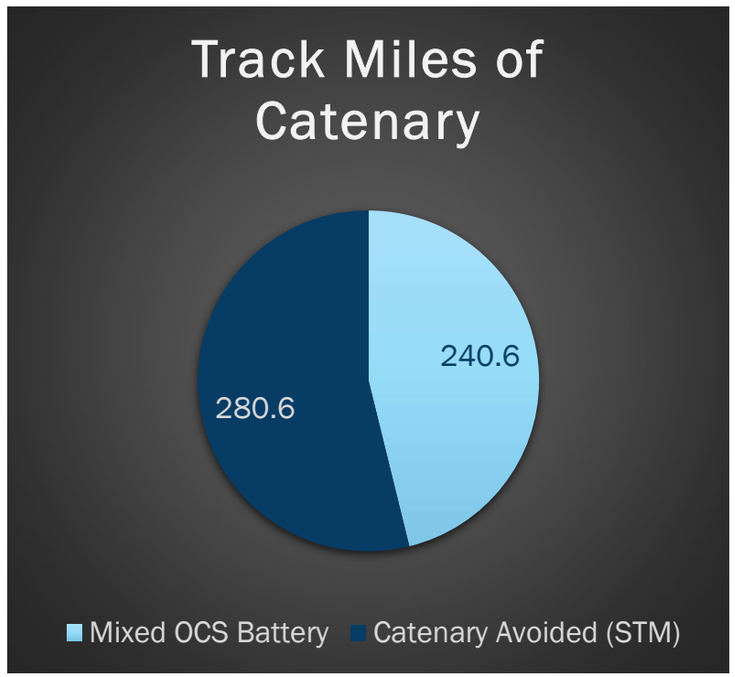
Analysis

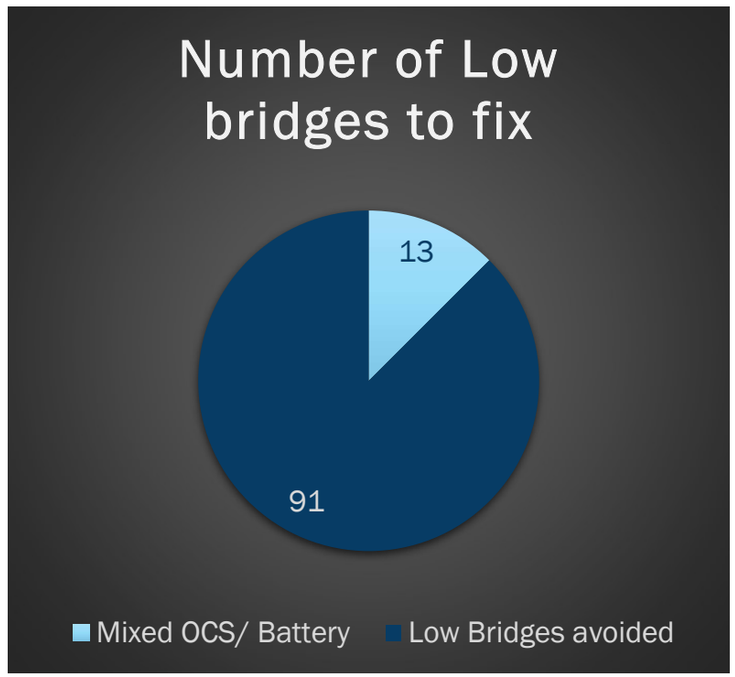
- Current analysis optimizing layout within constraints of battery power, charging, grid and structures



Illustrative Phase 1 layout

Overall Infrastructure Savings

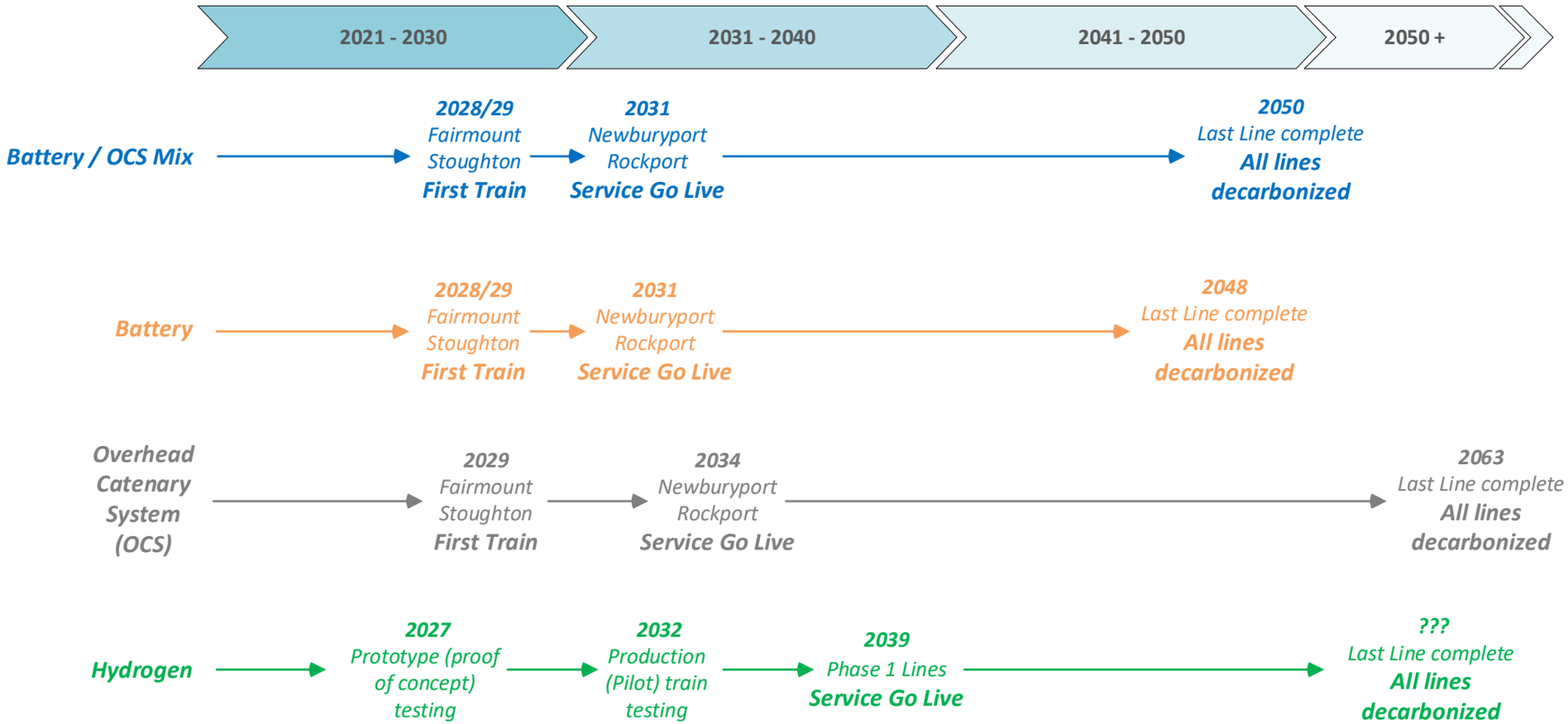




The OCS / battery mix concept *still achieves all Rail Transformation goals but* ***with a 90% reduction in clearance projects and a more than 50% reduction in catenary.***

Potential construction time savings

- Only Battery EMUs provide a solution able to meet the State Net zero target of 2050



Taken from Decarbonization Roadmap 7 April 2021

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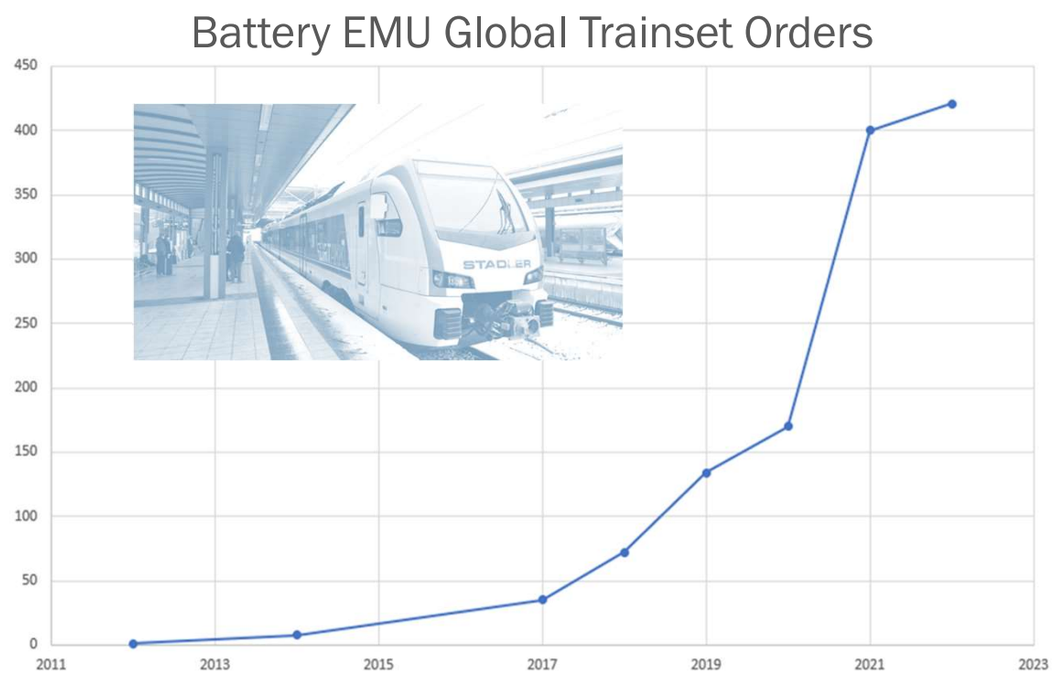
Discontinuous Electrification Maturity

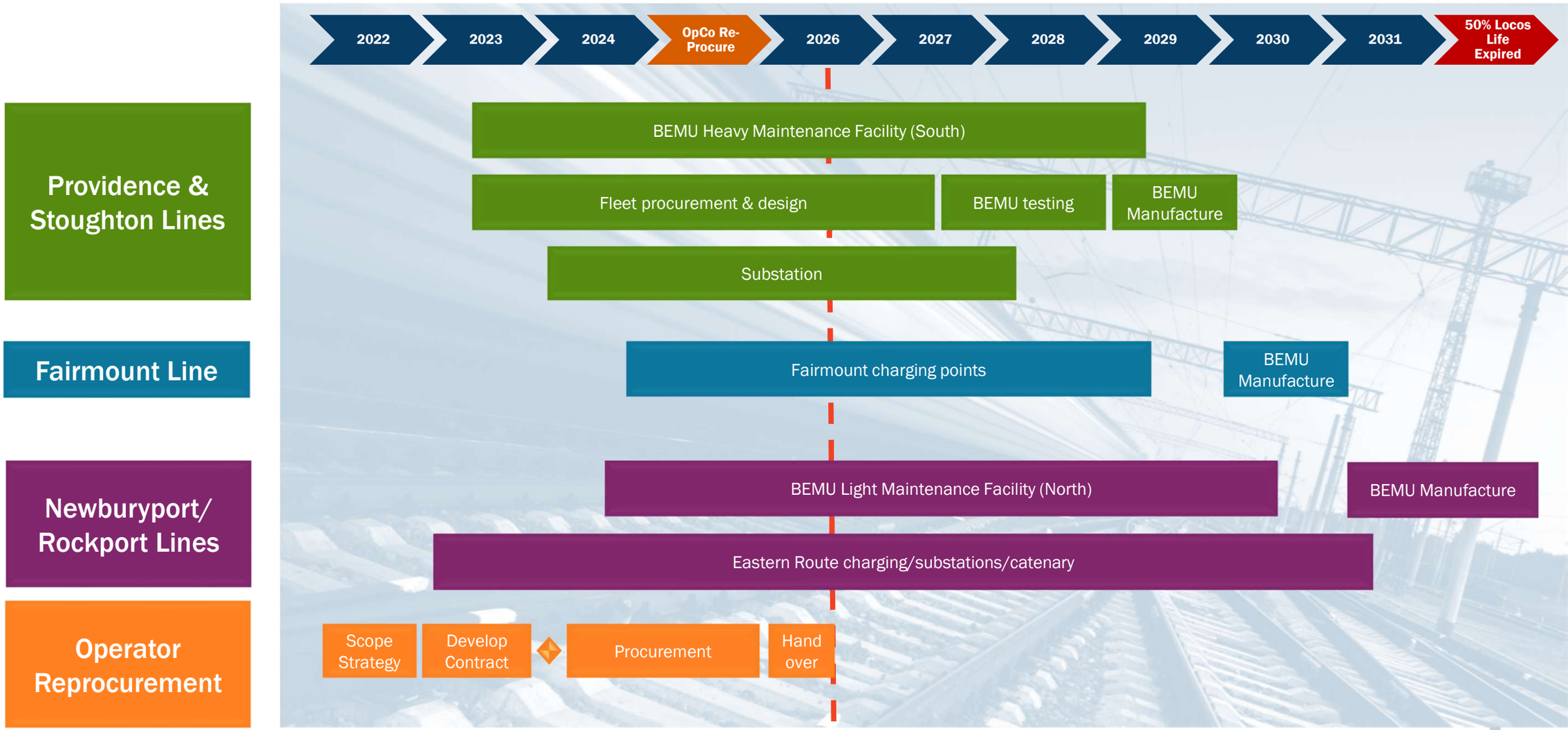
- Challenges
  - No battery trains in revenue passenger service in North America
  - Safety regulation still under development (based on bus)
- Mitigants
  - Battery locomotives are in US freight revenue service
  - Global order book for battery trains is significant and growing: 420+ trainsets in 7 countries
  - Pilots are underway based on retrofits of EMUs
  - MBTA working through an RFI process to validate assumptions



Future Fleet Procurement

- Battery-Electric Multiple Unit RFI was issued December 2021
  - 5 manufacturers responded
  - One on one meetings underway
  - Responses validated assumptions used for power analysis
- Typical procurement timeline 5-6 years
  - Consultant onboarding 6-9 months
  - Develop Request for Proposals & performance requirements 6-9 months
  - Issue RFP to notice to proceed 10–12 months
  - NTP to first trainset delivery is 36–42 months
  - 1 year of testing first trainset before revenue service
  - Production – typically 1 trainset per month
- New Heavy Maintenance Facility is on critical path
  - BEMUs require different maintenance facilities
  - Cannot be combined with Diesel locos

Illustrative Timeline



No Regrets Projects

No regrets projects

New Projects/Programs

- Turn track projects to enable/expand urban rail services
  - Fitchburg Line – 30 min Brandeis (or Lincoln) service
  - EJ Corridor – 30 min Beverly service extension
  - Haverhill Line – 30 min Reading service
  - Lowell Line – 30 min Anderson service
- Double Track regional rail studies
  - Old Colony hourly service (Quincy 20 min service)
  - Haverhill hourly service
- Service improvement studies
  - Fairmount Line frequency improvement
  - Worcester Line service planning
  - Boston-Providence electrified service

Planned Urban Rail Service Area

No regrets projects

Existing Procurements/Initiatives

- Franklin Line double track phase 3
- Design standards
- South Side Heavy Maintenance Facility (HMF) design
- Worcester triple track design
- Station projects: Lynn, Ruggles, South Attleboro
- Service schedule pilots
- Fare Transformation Phase 5
- Overnight layover planning & projects
  - Haverhill layover
  - Readville layover (southside)

Providence Line Electric Loco Pilot

- Providence Line already electrified to Providence
  - Missing 1.7-mile gap at Attleboro station is being filled summer 2022
- Investigating leasing Amtrak locomotives
  - Study potential modifications required to connect coaches
  - Investigating use of Amtrak layover & maintenance contracts
- Coordinate with Amtrak
  - Potential schedule improvement
  - Excess locomotives once new Avelia Liberty starts late 2023

Regional Rail Investments in the FY23-27 CIP

No Regrets Projects

- Rail Transformation – Early Action Items (P0940): $10M total authorized budget ($9.5M programmed spend in FY23-27)
  - 30min Brandeis/I-95 Urban Service (Fitchburg Line)
    - Planning new turn track – site selection (Est $6-7M)
    - Expected duration 18-24 months
    - Target completion 2024
  - 30min Reading Highlands Urban Service (Haverhill Line)
    - Planning new turn track at Reading station (Est $1.5-2M)
    - Expected duration 12-14 months
    - Target completion 2023
  - Beverly Urban Service Resiliency (Environmental Justice Corridor)
    - Extension of Beverly Turn Track ($300k) in planning
    - Target completion end of 2022
  - Investigating 30 min Anderson/Woburn Urban Service (Lowell Line)
    - Improve access to existing siding (Est $1M, 6 months)
    - Target Completion 2023-24

Planning

- Rail Transformation Planning Studies (P0934): $13M total authorized budget ($7.5M spent, $5.5M programmed spend in FY23-27)
  - Technology Study $3M – Completion 2022
  - Strategic Planning & Rail Vision ($4.5M spent) - completed
  - Planning for Re-procurement – ongoing
  - Service Planning – Fairmount Line Frequency improvement
- Future Rolling Stock Fleet (P0918): $50M total authorized budget ($49.9M programmed spend in FY23-27)
  - Planning future procurement of electrified or multi-mode Commuter Rail rolling stock
    - RFI Process 6 months
    - Decision to procure late FY2023
    - Develop Request for Proposals & performance requirements 6-9 months
    - Planning/feasibility for electrified service Boston-Providence

Appendix

Rail Vision – Regional Rail Concept

- Regional rail
  - “Clock face” scheduling
  - Local service
    - All day bi-directional service
    - 20-30 minute headways
  - Skip-stop service
    - To reduce journey time for outer stations
    - Start local and switch to express
    - Current example Worcester services express from Framingham
  - Express service
    - Focused on “key” stations

Rail Vision – Urban Rail concept

- Service level
  - High frequency bi-directional service
  - 15-20 minute headways
  - Rapid transit fare structure
- Inside Route 128/I-95 with turns at:
  - Beverly
  - Reading
  - Anderson/Woburn
  - Beyond Brandeis*
  - Riverside or Framingham (lower frequency)
  - Readville (all of Fairmount line)
- Single service pattern on
  - Providence/Stoughton
  - Needham
  - Franklin
  - Old Colony and SCR Phase 1

*Still studying potential sites

Resulting Program Scope

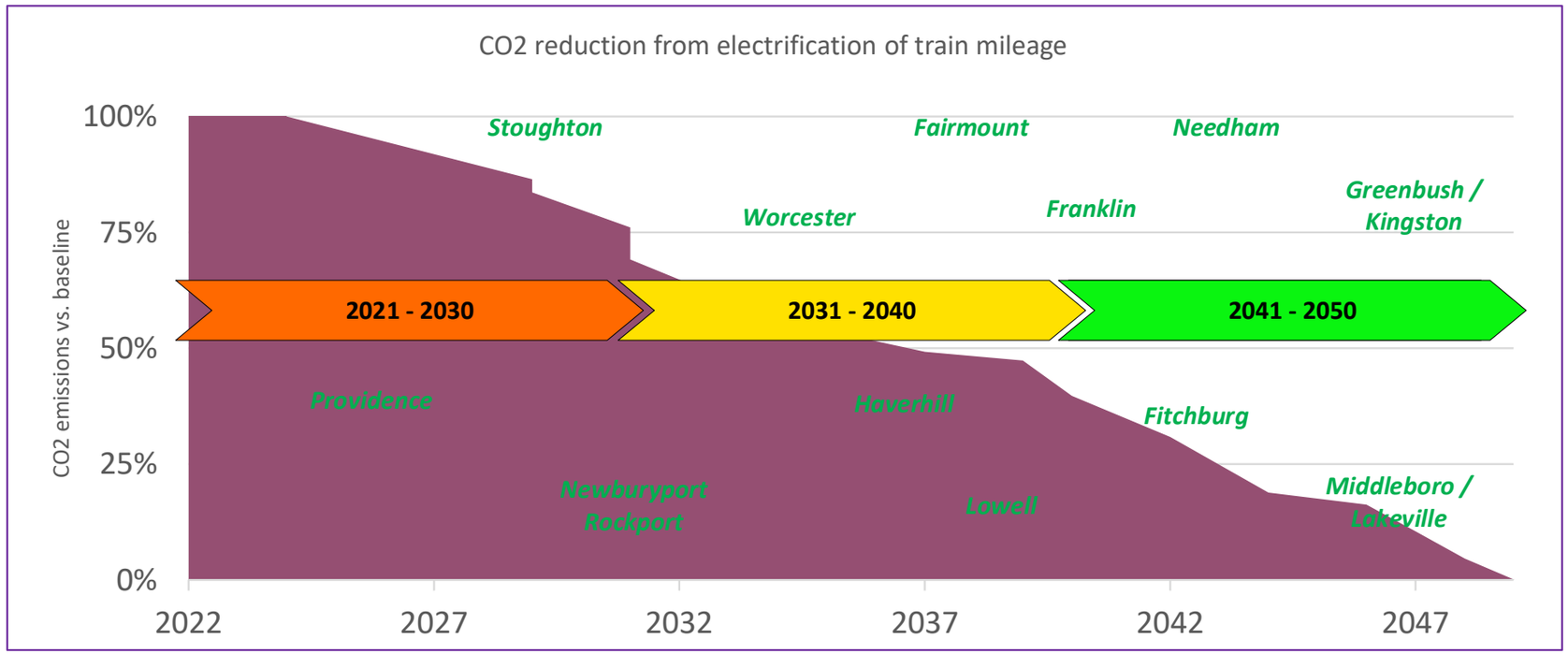
Operations

- Service Planning
  - Journey time improvements
  - Easier connections
  - Schedule integration with bus
- Fares
  - Regional & Urban rail customer targeted products
- Frictionless transfers
  - Fare integration with first/last mile
  - Single media – AFC 2.0
- Improved Customer information
- Key Performance data gathering
  - Monitor delivery of goals
- Rolling Stock
  - Continued enhanced cleaning
  - Improved on board experience & facilities with new equipment

Infrastructure

- Stations
  - Bus stops & drop off facilities
  - Pedestrian & bike access, wayfinding
  - High level platforms & accessibility improvements
  - State of good repair & brightening
  - Parking – Auto & bicycle
- Transit Oriented Development
  - Land
  - Mitigations
  - Equity and affordability
- Network improvements
  - Turn tracks
  - Drawbridge replacement
  - Double & Triple Track
  - Signal improvements
  - Grade Crossing improvements/new grade separation
- Electrification
  - Elimination of bridge clearance issues
  - Power feeds & facilities
  - Mix of battery and catenary

Illustrative Decarbonization Timeline



Assumed Technology:

Green – Battery & OCS mix

Please note:

- Preliminary results based on energy modeling at the line level only
- Phasing purely indicative and financial unconstrained
- Does not include construction or infrastructure maintenance carbon emissions
- Assumes all energy continues to be sourced from renewables
- Baseline is 2019

Updated from presentation at FMCB April 2021

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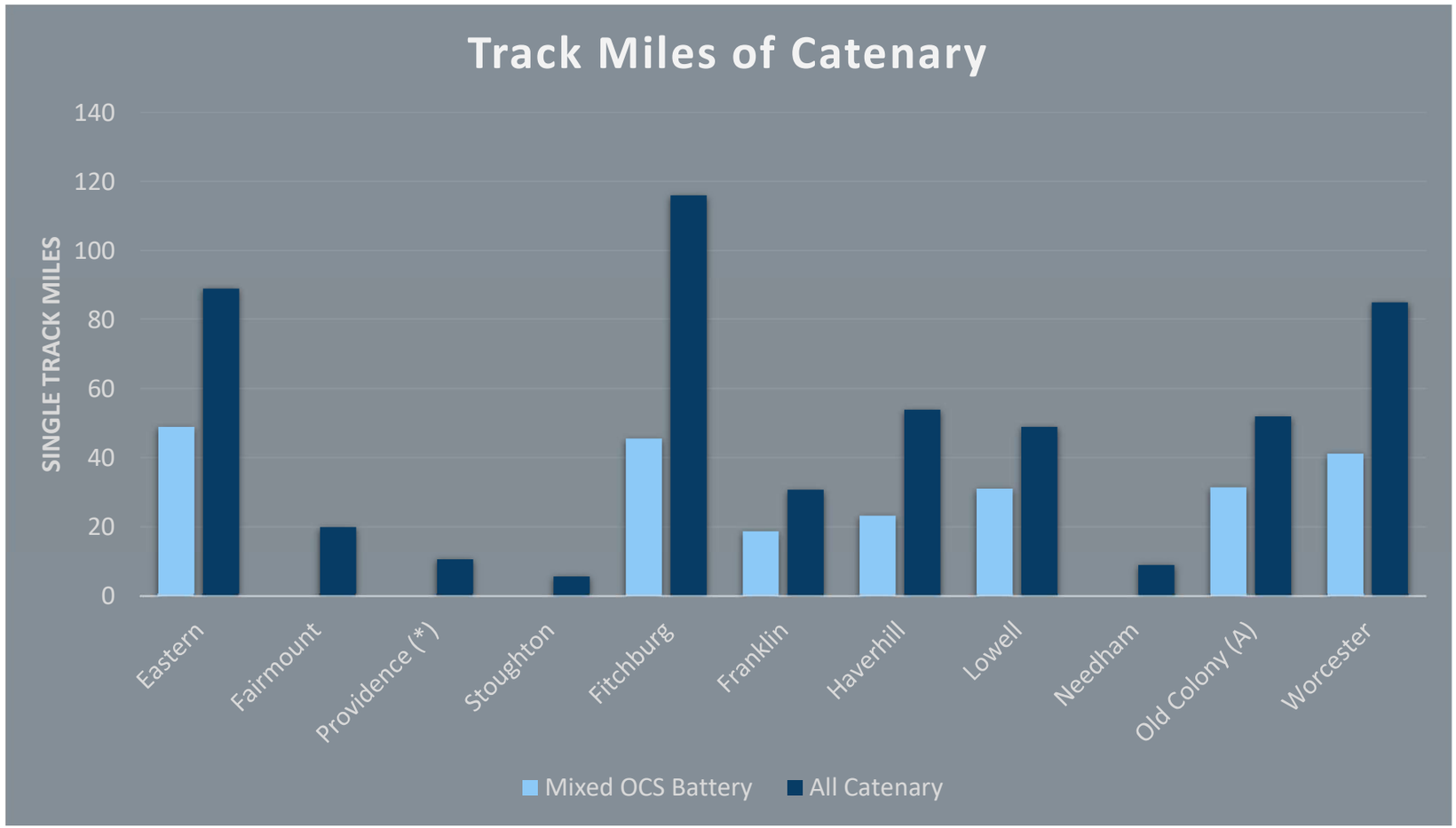
Line level OCS reduction



Note: 1 mile of double track is 2 Single Track Miles (STM) of Catenary * Missing Providence Line OCS is in RI and would be RIDOT cost saving

Good Planning: Spend the least, save the most