RSAC

Electronic Controlled Pneumatic (ECP) Train Braking Modernization Task Group

U.S. Department of Transportation
Federal Railroad Administration

October 3, 2024

ECP Task Group Charter

Opportunity Statement:

Identify potential methods of modernizing train brake equipment and brake-related processes and procedures to improve train braking effectiveness, including consideration of the use of electronically controlled pneumatic (ECP) brake systems.

Description:

The Task Group (TG) will evaluate the feasibility of requiring ECP brake implementation on HHFTs and other trains transporting large quantities of hazardous materials, trains of a certain length, and trains using any number of DP units.

Group Objectives

1. Determine any changes to ECP brake technology or challenges to its implementation and identify any potential improvements since PHMSA repealed the HM-251final rule.
    a. Identify changes
    b. Determine challenges
2. Determine the logistical and financial feasibility of ECP brake technology implementation on HHFTs and other trains transporting large quantities of hazardous materials, trains of a certain length, and trains using any number of DP units.
    a. Define cases
    b. How do we address challenges
    c. Update financial findings from 2018 rule to 2024.

TG Team Members:

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Nataka Neely – FRA
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Team overview of challenges:

- ECP Operation
  - Reviewed **emulation**, **stand-alone**, & **overlay** modes of operation
    - **Emulation does not** provide ECP benefit when not receiving signals from ECP locomotive
      - Team consensus – Emulation is not practical in freight service.
      - Must have intact electric trainline to support brake application
      - Freight cars need to have power source to charge batteries
    - **Stand-alone** not viable solution for industry implementation
      - Team consensus – Stand-alone ECP is not a practical path for critical mass expansion
      - Hurdles and challenges to rail operations is high due to competing modes of operation
      - Stand alone ECP is not interoperable with conventional air brakes.
      - Equipment failures lead to major network disruptions

Team overview of challenges:

- ECP Operation (cont'd)
  - **Overlay** ECP provides more flexibility
    - Benefits
      - Dual mode of operation – conventional or ECP
      - Allows for operating flexibility and expansion
      - Would be less disruption to the North American Rail Network
    - Hurdles
      - ECP equipment degradation (i.e., batteries, connectors) waiting on critical mass to operate ECP
      - Equipment retro-fit or new-builds would likely need refurbished prior to operation
      - Two types of operating systems (ECP and Conventional) inflates cost and support
        - Material carrying costs and storage capability across a broad network
    - Maintenance processes
      - Higher maintenance
      - SCABT – two types to perform when on repair track
      - New equipment needed to perform tests and inspections
      - Training for ECP equipment is much different than conventional air brakes

Team overview of challenges:

- Regulatory concerns
  - Conventional trains require a Class 1 Brake Test prior to departing initial terminal
  - ECP trains require a Class 1 Brake Test every 3500 miles (vs. 1000 or 1500 conventional)
  - Overlay systems can operate conventional or ECP, over the road failures would require immediate brake test of the alternate system unless redundant testing is performed at initial terminal
  - Update required tests and inspections for maintenance and train operation
- Interchange with short lines, utilities, other US carriers, and cross-border railroads
  - There is a need for flexibility across networks and international borders to limit disruptions
  - Rules governing use of alternative braking system
  - Foreign carriers/utilities having the means to operate equipment
  - Vandalism / theft
- Testing of ECP equipment in train yard
  - Class 1 test cannot be performed with conventional yard test equipment
  - ECP outbound brake test requires an ECP equipped locomotive to command and control
  - Locomotive utilization will be impacted without further development of ECP brake testing tools

Team overview of challenges:

- ECP conversions
  - Where would the work be performed
    - Repair tracks are not feasible, program work only (16 person hours for 1 installation)
    - Private contractors may be required
  - Remaining equipment life would be a factor
    - Freight car – 50 years
    - Locomotive – 30
    - Cars with short remaining life span would likely be removed from service due to the need for each car to have a communication path to an ECP locomotive
  - Cost
    - ~10K per car estimated material and labor
    - ~50k per locomotive with modern (EBV) brake systems, estimated materials and labor.
    - Estimated 30 days out-of-service for each car (lost opportunity cost)
    - Surplus equipment would be needed to cover out of service time
    - Costs need further analysis pending final cost/benefit review
  - Timeline for conversion
    - Continuing to forecast as other information is gathered

Team overview of challenges:

- HHFT – Length required
  - Prior recommendations by proposed rule to require ECP operation
    - More that 20 HHF cars coupled
    - More than 35 HHF cars at different locations within a train
  - ECP operational and safety benefits are not possible without communication from an ECP lead equipped locomotive to ECP equipped cars in a mixed consist train
  - Operating HHFT as proposed would force roads to operate small ECP trains without any benefit
    - ECP trains with 20-35 cars will not have improvement in stopping distances
    - Shorter trains will lead to additional crews to operate the shorter trains
    - Locomotive fleet utilization would be strained
    - Short HHFT or HHFUT trains would fundamentally change rail operations

Team overview of challenges:

- **Short line Challenges**
  - Training requirements for a smaller and less specialized workforce
  - Stocking repair parts for ECP would be costly
  - Unit trains are delivered to short lines, but the short lines often deliver cars to the customer in smaller pieces, requiring more coupling and uncoupling of ECP cables, and more opportunities for connection problems
  - Short line locomotives tend to be older and commonly use 26L equipment, costs of installing customized ECP would be greater than for newer locomotives
  - Many short line locomotives would be unable to be modified for ECP

Task Group Approach

Identified ECP Brake Improvements since 2018.

1. Train Roll Away Protection improved
2. Improved Trainline Communication Reliability:
    - Increased communication loss timing threshold, improved trainline accessories (locomotive/car), improved trainline power filtering & isolation, and improvements/advancements in intercar cable design
3. Optimized ECP Train Initialization (Improved ECP Set-up Time)
4. Next Generation Battery/Power Supply Technology:
    - Enhanced life and optimized device power consumption
5. Onboard Power Capabilities (power on each vehicle):
    - Allows for addition of car sensors. Sensors in use today: handbrake status, empty/load, hatch/door status

Evaluated alternative ECP systems: Identified pros & cons considering railroad operations, crude oil & ethanol logistics, and technical requirements to determine technical feasibility.

1. Standalone
2. Emulation
3. Overlay

Task Group Approach

Identified implementation steps and timeline for costs & benefits. Holistic approach considering changing landscape & aspects not considered in prior rulemakings with broad representation from labor, OEMs, railroads, shippers.

- Supply chain impacts
- Business models – railroads & commodities
- Need for new rules to address overlay systems (vs standalone) in Part 232
- Software integrations with locomotive operating algorithms
- Specialized or modified EOTs
- New and enhanced technologies, processes, etc

Adjusted 2017 DOT methodology for estimating benefits to distinguish between HHFUT/HHFT accidents and rates (a mixed manifest train with <20 ethanol cars will not operate with ECP brakes, even though ethanol cars may have ECP). Non-HHFUT accidents cannot be in HHFUT accident pool, non-HHFT cannot be in HHFT pool.

Developed methodology for estimating environmental benefits.

ECP Alternative System Type Evaluation: Standalone, Overlay, & Emulation

(Task Group determined that overlay is presently the only feasible method for U.S. Freight)

<table>
<tr><th></th><th>Standalone</th><th>Overlay</th><th>Emulation</th></tr>
<tr><td>Network Disruption Risk (Inoperable ECP enroute)</td><td>High risk. Passenger & goods (esp hazmat) movement impacted for extended duration. Troubleshooting 80+ cars takes too long/train can't move.</td><td>Medium risk. Continue moving with conventional brakes after long delay to manually switch all cars to conventional brakes and performing Class 1 Brake test before continuing.</td><td></td></tr>
<tr><td>Power Source Risk</td><td colspan="2">The 220-volt trainline may be a source of ignition; lithium-ion batteries on brake valves can be source of ignition. This can be mitigated, but the fire risk should be addressed.</td><td>Power supplies may be source of ignition.
Additional risk due to loss of main power source. Car battery insufficient backup.</td></tr>
<tr><td>ECP Required on HHFUT: Equip non-ethanol cars

Short line Feasibility.</td><td>Ethanol cars in mixed manifest trains at collection/distribution points trigger ECP requirement for non-ethanol cars since trains cannot operate in mixed ECP/Conventional mode. Substantial additional cost to equip non-ethanol cars OR run more trains so ethanol moves alone.

Not feasible for short lines.</td><td><70 ethanol cars in mixed manifest trains at collection/distribution points: ALL cars must operate in ECP or conventional. Additional cost to equip non-ethanol cars OR perform 2 brake tests predeparture OR develop a dual-system Class I brake test.

Feasible for short lines.</td><td>--
Not feasible for short lines.</td></tr>
<tr><td>ECP Required on HHFT (broader than HHFUT)</td><td colspan="3">Ethanol cars in mixed manifest trains trigger ECP requirement for non-ethanol cars. Cost prohibitive and additional years to equip entire fleet of cars (except coal and grain) without disrupting supply chain. Benefits greatly delayed.</td></tr>
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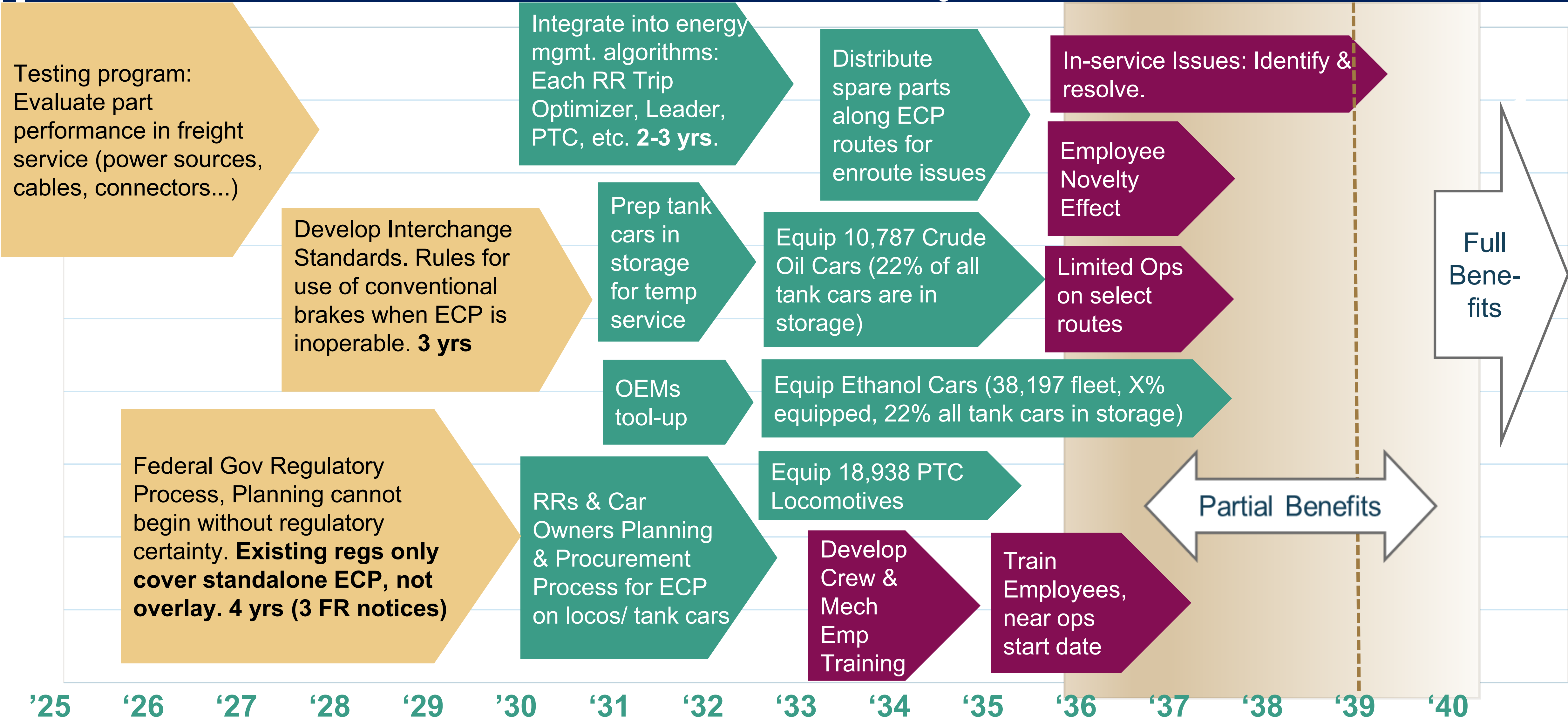
ECP Overlay HHFUT (vs HHFT) Implementation Timeline

Limited Benefits 2036-2039. Full Benefits Begin~2039



HHFUT Sensitivity Analysis & Alternatives

Shorter HHFUT Timeline (sensitivity analysis)

- Shorter timeline may result in higher costs.
    - Building additional facilities and infrastructure
    - Employee overtime
    - Temporary car shortages
    - Over hire of employees for short term
    - Accelerated rulemaking may result in regulatory uncertainty

HHFUTs embedded in trains carrying other commodities must still be addressed in timeline (alternatives to consider)

1. Separate into different trains. Additional cost for locomotives, fuel, crew, and potentially slow down network.
2. Equip non-ethanol cars with ECP brakes, potentially extend timeline.
3. Other solutions? If such trains do not operate in ECP mode safety, business, & environmental benefits will not accrue.

Findings

1. **ECP Overlay is only feasible option for US Freight Operating environment.**
   - Standalone and emulation are not feasible
2. **Quantitative cost and benefit analysis needs to be completed (see next slide)**
3. **Formal testing is required to validate ECP enhancements identified by Group 1 (batteries, cables/connectors, power supplies, etc)**
4. **BTS data is most appropriate source for car fleet and carload data**
   - Bureau of Transportation Statistics (BTS) data is reported in format necessary and available publicly
   - Energy Information Administration (EIA) does not provide car fleet or carload data – only product quantity, in barrels, are reported.
   - Surface Transportation Bureau (STB) Waybill data requires complex analysis and is not publicly available.
5. **Ethanol shipment logistics are complex (vs. crude oil) due to dispersed gathering and distribution points & large but varying movements in mixed freight trains**
6. **51% effectiveness of DOT 117 tank cars (vs DOT 111s) limits benefits for ECP brakes relative to 2017. DOT 111 tank cars have been phased out for ethanol & crude oil.**
7. **Adjustment to methodology for calculating the derailment rate & ECP effectiveness rate for HHFT vs HHFUT. No benefits for ethanol cars not in HHFUT/HHFT service.**
8. **Fewer reportable accidents with release in recent years: 3 HHFUT accidents 2019-2023**

Next Steps to analyze changed landscape of cost & benefits

1. Full Costs over 20+ years: HHFUT & HHFT

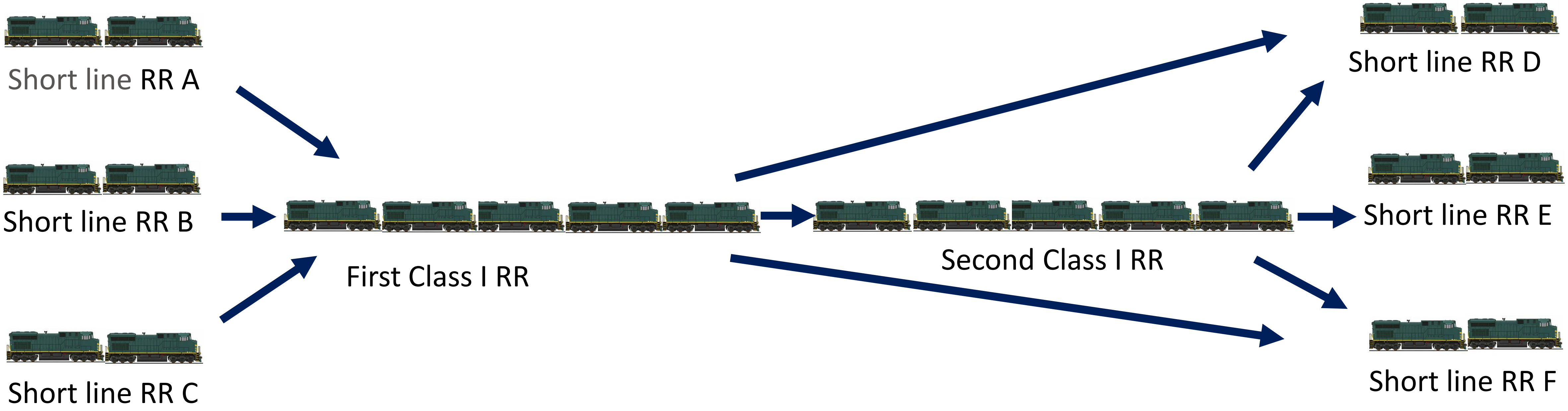
- Implementation
- Operation & Maintenance
- Training
- Integration with existing operations Software/Algorithms
- Consider alternative locomotive scenarios (dedicated ECP locomotives, and spares, to run dedicated routes vs using only existing fleet)
- Solution for mixed freight trains with HHFUTs embedded within

2. Full Benefits over 20+ years: HHFUT & HHFT

- Safety
  - Derailment Rate, ECP Effectiveness Rate specific to HHFUT and HHFT
- Environmental (fuel emissions)
- Business
- Adjustments for technological advances and new initiatives that will deliver safety, environmental, & business benefits sooner (equipment health monitoring, data analytics, wayside detectors, alternative fuels)

Ethanol Logistics from Plants to Blending Facilities

- Generally, railroads do not share/interchange locomotives with short lines.
- Collection & distribution points are geographically dispersed.



- Assuming 4 dedicated locomotives from origin to destination does not reflect the reality of ethanol moves by rail.

- However, dedicated locomotive fleets for dedicated routes can be evaluated.