



Operations and Maintenance (O&M) Costs Technical Memorandum

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Submitted by:



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1. Introduction

1.1 PURPOSE OF ANALYSIS

The Federal Railroad Administration (FRA) prepared the operations and maintenance (O&M) cost estimates to provide representative estimates of the costs to operate and maintain the proposed Service Plans¹ for the Tier 1 Draft Environmental Impact Statement (Tier 1 Draft EIS) No Action and Action Alternatives. This technical memorandum documents the data sources, key assumptions, and approach used to estimate these O&M cost projections for the NEC FUTURE program (NEC FUTURE). The methodology produced high-level, order-of-magnitude estimates for O&M costs appropriate for a Tier 1 Draft EIS level of review. In conjunction with the capital cost estimates, these O&M estimates facilitate comparative cost analysis between the No Action and each Action Alternative, and, for Intercity services, assess whether the proposed Service Plans are likely to generate an operating surplus where revenues exceed costs.

Where available, the FRA used data on recent actual Amtrak and commuter-rail O&M costs as a starting point for the analysis. The availability of this information varied across the type of rail service and cost category, and was supplemented by additional cost estimates where needed to provide a more comprehensive data set. To facilitate consistent application of cost estimates across all proposed NEC FUTURE Service Plans, the FRA combined these data, generalized them across the corridor, and applied them based on key assumptions about the operational characteristics of the NEC FUTURE service types (e.g., Intercity-Express, Intercity-Corridor, Metropolitan, and Regional rail, as further defined in the *Service Plans and Train Equipment Options Technical Memorandum*).

The estimation of O&M costs for the NEC FUTURE alternatives considered the following assumptions and data availability constraints:

- ▶ **Amtrak O&M cost data is proprietary:** Amtrak actual costs by cost center and the resulting unit costs are important baseline inputs to the O&M cost estimates. However, these data are proprietary business information that is strictly governed by a non-disclosure agreement signed by the participants of this analysis. To respect this proprietary information, the FRA has reported the methodology of how these data were used, and presented summary-level results only. For this analysis, existing Amtrak services (i.e., Acela Express and Northeast Regional) are referenced solely in the context of applying currently available data. The source for this data does not presume the potential operator of NEC FUTURE proposed service.
- ▶ **Peer agency cost data is incomplete and unreliable:** Outside of the Northeast Corridor (NEC), there are no other passenger rail operations in the United States that share substantially similar operating characteristics to those proposed in the NEC FUTURE alternatives. Comparable international passenger rail data—in terms of unit O&M costs—are either governed by

¹ The Service Plans developed for the No Action and Action Alternatives are intended to be representational only, required for analysis of capacity, performance, and costs, as well as assessment of the environmental impacts associated with planned improvements. The Service Plans are not intended to be prescriptive regarding how service should be operated in the future. In addition, the Service Plans are not intended to predict future operating patterns of the NEC operators.

confidentiality considerations similar to Amtrak or are poor analogues to apply because of different specifications (e.g., vehicle weights, vehicle buff strengths), different operating speeds and frequencies, and lack of documentation.

- ▶ **California High-Speed Rail Authority (CHSRA) O&M costing methodology is confidential and applicable only on new alignments:** Only the most highly aggregate unit costs (e.g., total maintenance-of-way cost per train mile) are available from the CHSRA O&M cost methodology. The FRA used the unit costs derived from the CHSRA data to estimate costs for new segments and do not represent typical costs for the exiting NEC.
- ▶ **Unit O&M costs for NEC FUTURE Regional services are not available from the commuter railroads:** The commuter railroads do not have O&M cost models. The only available source of cost and operational data for these services are the National Transit Database (NTD) reports that are submitted by those agencies to the Federal Transit Administration. The NTD data provide limited ability to develop useful unit costs, particularly for maintenance-of-way, because all non-vehicle maintenance functions (e.g., track, structure, power, signal, and communications) are combined, even though the underlying cost drivers for these individual functions are different.

1.2 STRUCTURE OF TECHNICAL MEMORANDUM

The FRA structured this technical memorandum to present the step-by-step process used to develop the O&M costs. Section 2 discusses the approach taken to develop the O&M cost estimates and how the approach incorporates best practices in estimating high-speed rail O&M costs. Section 3 provides an overview of the model structure. Section 4 discusses the various data inputs and sources of information. Section 5 presents a discussion on the unit cost calculation and application. Section 6 presents the summary-level analytical results for the No Action and Action Alternatives as well as a high-level contribution analysis comparing all alternatives.

2. Methodology

The FRA used the Office of Inspector General’s (OIG) June 2011 report entitled *HSIPR Best Practices: Operating Costs Estimation* (OIG Report) as a key reference document in developing the O&M cost model.² In particular, the FRA used Section 4, “Best practice: preliminary stage proposals,” to structure the O&M cost estimates for NEC FUTURE. That section identified the following seven key cost areas that provide clear groupings under which O&M costs can be categorized:

- ▶ Train crews: drivers, conductors, onboard services (OBS)
- ▶ Energy: diesel fuel or electricity costs associated with train propulsion power
- ▶ Stations: ticket sales, customer information and train dispatching services; station building utility and maintenance costs
- ▶ Rolling stock: lease payments on rolling stock are considered an operating cost
- ▶ Train maintenance: routine planned maintenance of the rolling stock fleet; maintenance resulting from vandalism and accidents; includes all costs associated with train cleaning
- ▶ Railroad: costs to operate and maintain the railroad (infrastructure) for a specified train service plan
- ▶ General and Administrative (G&A): management, marketing, sales and reservations, all general office expenses

For the proposed NEC FUTURE service types, all but the rolling stock cost area are anticipated O&M cost areas. The FRA included rolling stock procurement costs in the capital cost estimates.

The OIG Report also identified key elements of the representative Service Plans that contribute to estimating of O&M costs, including:

- ▶ Route operated
- ▶ Key stations served
- ▶ Train frequency
 - End-to-end (network) travel time and distance
 - Assumed/required turnaround times
 - Daily number of seats provided
 - Days of operation
 - Start and end time of service day

In addition to providing information on train frequency, these representative Service Plans provided the basis for calculating train hours and train miles—a critical input for estimating operating costs,

² Office of the Inspector General (OIG), 2011. *HSIPR Best Practices: Operating Costs Estimation*. U.S. Department of Transportation, Washington, D.C., <https://www.oig.dot.gov/foia-electronic-reading-room>.

since numerous resource needs (e.g., number of trains, propulsion energy, and staffing requirements) tend to vary directly with changes in train hours or in train miles. The Service Plans are intended to be representational only, required for analysis of capacity, performance, and costs, as well as assessments of environmental impacts associated with planned improvements. The Service Plans are not intended in any way to be prescriptive regarding how service should be operated in the future. Additionally, the physical characteristics, such as the route operated and stations served, provide the basis for determining route and track distances (e.g., route and track miles) as well as ridership. Changes in physical characteristics directly affect the level of resources required to maintain the railroad right-of-way as well as physical plant operations and cleaning.

General best practices in O&M cost modeling for transportation planning recommend leveraging the most recent, stable cost experience regarding current service operations and characteristics of technologies similar to that being proposed, as well as applying the operating plan at a level of detail that is consistent with the plan detail applied in the travel demand modeling. To comply with this recommendation, as well as the guidance from the OIG Report, the O&M cost model used recent (i.e., FY 2013) actual Amtrak cost experience to project O&M costs for Intercity service for the No Action and Action Alternatives Service Plans. The FRA used Amtrak cost data as a baseline for projecting costs for existing portions of the NEC. This assumption recognizes that the underlying NEC O&M costs are a function of the corridor's extensive existing operations, unique infrastructure and equipment maintenance needs, and detailed labor agreements. It also recognizes the availability of relevant and reasonably high-quality source data about the NEC cost experience. As such, the FRA did not use projected costs for other proposed intercity high-speed rail services (e.g., California high-speed rail, international high-speed rail) for the existing NEC territory.

To align the level of effort in developing the O&M costs to the conceptual level of detail in the No Action and Action Alternatives, the O&M cost modeling approach leveraged existing Amtrak financial data reports. One such report was the Amtrak Performance Tracking (APT) system report.

Since the NEC FUTURE Service Plans include corridor-wide Intercity and Regional rail service, the analysis needed to consider infrastructure-related costs (e.g., maintenance-of-way, train dispatching, propulsion, and physical plant maintenance) incurred on the territory that the Service Plans operate on, regardless of service or operator. These costs are representative of the Service Plans and associated infrastructure improvements, and were developed for planning purposes only. Assembling this data from existing Amtrak reports is difficult since O&M-related costs are allocated by Amtrak's current business lines and services. Thus, the O&M cost model leveraged an analytical tool—the cost aggregation database, which was developed for the Northeast Corridor Infrastructure and Advisory Commission (NEC Commission)—that captures the full O&M cost for infrastructure-related O&M activities on the existing NEC from Washington, D.C., to Boston. The cost aggregation database addresses the energy (e.g., propulsion power and maintenance), stations, and railroad cost areas mentioned in the OIG Report. Section 4.1.1 further describes the cost aggregation database.

The O&M cost model utilized the APT reports as source material for non-infrastructure-related Intercity costs, such as train crews, train maintenance, transportation operations, and G&A. These cost areas are service dependent (e.g., different crew or equipment requirements by service). Since

these costs are exclusively Intercity transportation- and equipment-related costs, the APT reports were the appropriate data source. Specifically, the APT report is utilized to address the energy (e.g., diesel train fuel), train crews (which includes train operations), train maintenance, and G&A (which includes sales and marketing and corporate operation costs) cost areas mentioned in the OIG Report. Section 4.1.2 provides further information on the APT report.

While O&M costs for segments of the existing NEC are based upon current Intercity costs in the corridor, some of the NEC FUTURE alternatives propose significant new, off-corridor rights-of-way as well as different equipment types that incur a different O&M cost profile. Thus, relevant unit costs for new high-speed rail operations for the proposed California High-Speed Rail project are included for new equipment (e.g., electric multiple-unit trainsets) and new off-corridor rights-of-way. These unit costs are utilized because of the following:

- ▶ Dedicated high-speed segments on new rights-of-way are designed to current international standards such as those proposed for the California system. It is unlikely that this new track hosts the same mix of varied and complex infrastructure and operations of the current or upgraded NEC.
- ▶ New multiple-unit high-performance equipment will have a different maintenance cost experience than the current equipment in use on the NEC today.

The unit costs for new high-speed operations address the train maintenance and railroad cost areas mentioned in the OIG Report. Section 4.4 provides further information on the unit costs applied.

To address non-infrastructure-related costs for the commuter-rail operators, the FRA used transportation-related commuter-rail costs to present a complete assessment of O&M costs for the projected Regional rail service. The FRA also used cost data from the NTD reports because the commuter railroads did not have their own O&M cost models for use in this analysis. While NTD reports recognized limitations (particularly in not separating different non-vehicle maintenance functions), they were the only sources of O&M costs and level-of-service data available for all NEC commuter operations. The FRA used right-of-way maintenance unit costs only for MTA-Metro-North Railroad because it owns the NEC right-of-way between New Rochelle, NY, and New Haven, CT. These costs address all the cost areas mentioned in the OIG Report. Section 4.1.3 provides further information on the commuter-rail costs.

Table 1 shows how each type of O&M cost discussed above and identified for use in the O&M cost model addresses the cost areas mentioned in the OIG Report.

Once the FRA assembled appropriate cost information, cost drivers were assigned to each cost group. The existing unit cost was calculated by dividing existing cost by the existing cost-driver value. The unit cost was then applied to the projected cost-driver value to obtain the forecast O&M cost.

Table 1: O&M Cost Areas Addressed by Various Cost Data Types Used in the O&M Cost Model

Type of Cost for Use in O&M Cost Model	Office of Inspector General Best Practice Cost Area Addressed					
	Train Crews	Energy	Stations	Train Maintenance	Railroad	G&A (incl. sales & marketing, corp. mgmt.)
Intercity infrastructure-related		✓ (<i>electric propulsion</i>)	✓		✓	
Intercity train-based, transportation service and national operations	✓	✓ (<i>diesel fuel</i>)		✓		✓
High-speed operation on new right-of-way and for new equipment				✓	✓	
Transportation-related commuter-rail costs for operators along the NEC	✓	✓	✓	✓	✓ (<i>where applicable</i>)	✓

Source: NEC FUTURE team, 2015

The NEC FUTURE Service Plans are different from the existing service, and the operating and physical characteristics associated with the proposed Service Plans are likely to alter O&M cost experiences. Thus, the FRA used these representative Service Plans to evaluate certain impacts to unit costs resulting from efficiencies in technology or inefficiencies in capacity. These impacts were implemented as adjustment factors and multiplied to the existing unit costs to obtain the projected unit costs. Section 5.3.2 presents further discussion on these factors.

To achieve the objective of determining whether the proposed Intercity service results in an operating surplus, the FRA subtracted forecasted O&M cost from the forecasted revenue, which yielded the net contribution amount. A positive net contribution indicates that the Intercity revenues exceed the O&M cost of the representative Service Plan.

3. Model Structure

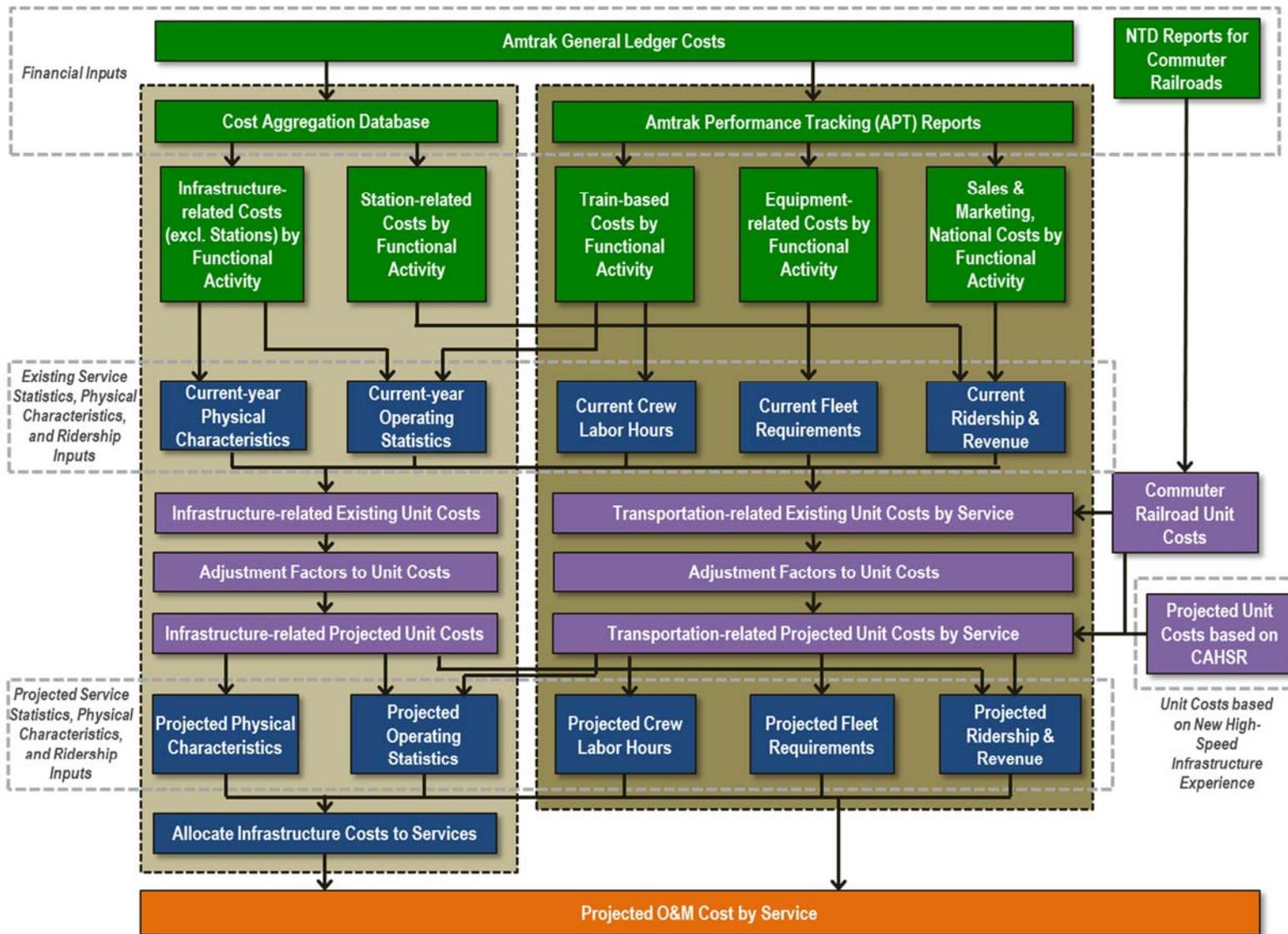
The O&M cost model is a Microsoft Excel-based spreadsheet model that compiles various data inputs from a number of sources, which derive unit O&M costs through a transformation of the cost data and level-of-service information. Unit costs are generally derived function-by-function as cost divided by either quantity of service or physical characteristics. The FRA then applied these unit O&M costs to projected level-of-service and physical characteristics information to produce O&M cost forecasts for the No Action and Action Alternatives for each of the proposed NEC FUTURE service types.

Figure 1 describes the model structure applied in the O&M cost model, which consists of the following five major elements:

- ▶ Data input elements are surrounded by a **light gray** rectangle with dashed lines.
- ▶ Cost/financial data elements are shaded in **green**.
- ▶ Cost-driver variables elements are shaded in **blue**.
- ▶ Unit cost elements are in various shades of **purple**.
- ▶ The application element is shaded in **orange**.

Solid arrows indicate the direction of data flow and that the element is directly used in a calculation. The elements surrounded by a **light-tan**-shaded rectangle represent the process to derive infrastructure-related unit costs and O&M cost projections. Elements surrounded by the **dark-tan**-shaded rectangle represent the process to derive transportation-, equipment-, and G&A-related unit costs and O&M cost projections.

Figure 1: O&M Cost Model Structure



Source: NEC FUTURE team, 2015

The O&M cost model is structured in a series of sheets within a single file that addresses the following sequential phases:

- ▶ **Cost identification and aggregation.** The O&M cost model first identified the O&M costs from each cost/financial data input (e.g., the cost aggregation database, the APT reports, or the NTD reports) that represent the O&M costs associated with the representative Service Plans for the No Action and Action Alternatives and are the types of costs identified in the OIG Report. The FRA then aggregated these costs to a corridor-wide level by type of cost (e.g., by cost area) and by functional activity. Transportation- and equipment-related costs (e.g., costs from the APT reports) were also aggregated by existing service type (e.g., Acela Express, Northeast Regional). This level of aggregation is acceptable for a Tier 1 Draft EIS review since it captures high-level costs related to major O&M activities that are driven by a different cost driver.
- ▶ **Cost-driver variables.** The O&M cost model then incorporated from the various cost-driver inputs the existing physical characteristics (e.g., the number of track miles), operating statistics (e.g., the number of train miles, train frequency), crew labor hours, fleet requirements, and ridership and revenue data. The FRA assigned costs associated with each functional activity a cost driver based on industry knowledge and experience. For infrastructure-related cost areas and functional activities, the FRA selected an allocation driver to allocate those costs to the various users of the infrastructure based on industry knowledge and experience.
- ▶ **Unit cost.** To calculate the existing unit costs, the O&M cost model divided the existing costs aggregated by cost area, functional activity, and by service (e.g., for train crews and operations, train maintenance, and G&A cost areas) by the appropriate existing cost-driver variable. Recognizing that there may be some efficiency gained from new technologies, or some inefficiency resulting from increased corridor traffic/density, the O&M cost model multiplied the existing unit costs for certain functional activities by adjustment factors to calculate projected NEC FUTURE unit costs.
- ▶ **Application.** To determine the O&M cost forecast for the No Action and Action Alternatives, the O&M cost model multiplied the unit costs by cost area, functional activity, and by service (where applicable) with the projected cost-driver values. The projected unit costs were applied to the increment of cost-driver value above the current conditions; the existing unit costs were applied to existing amount of the cost-driver value.

Section 4 describes the data input in detail, while Section 5 describes each of the four phases mentioned above in detail.

4. Data Inputs

This section describes the four categories of data sources utilized in the O&M cost model. Section 4.1 describes financial inputs. Section 4.2 describes existing physical characteristics, services statistics, and ridership. Section 4.3 describes projected physical characteristics, service statistics, and ridership. Section 4.4 describes the unit costs based on new high-speed rail infrastructure.

4.1 FINANCIAL INPUTS

The financial inputs to the O&M cost model include Amtrak's general ledger (for the cost aggregation database and the APT reports) and the NTD (for the commuter railroads). The FRA derived unit costs using Amtrak FY 2013 data in 2013 dollars.³ Application of the unit costs, discussed in Section 5, included a conversion to 2014 dollars using appropriate Association of American Railroads inflation indices.

4.1.1 Cost Aggregation Database

The NEC Commission maintains the cost aggregation database, which is a Microsoft Access-based database that contains all actual costs reported in Amtrak's general ledger for fiscal year 2013. The database identifies shared infrastructure-related operating costs for six major cost areas and 19 functional activities. Costs are associated with geographic segments. Costs are aggregated by cost center, by internal order, and by cost element. The internal order information generally denotes the functional activity, while the cost element information differentiates salary, wages, materials, and other cost categories. Costs are classified as either a direct cost, which are traceable to a specific physical asset or service provided to customers (e.g., maintenance-of-way or maintenance of equipment), or indirect costs, which are shared across multiple routes or services (e.g., supervision, support, and administrative functions).

Actual Amtrak cost experience was the source of the projection of costs for shared infrastructure (electric propulsion, maintenance-of-way, police (road, yard, and station), power directors, train dispatching, and station maintenance) for the No Action and Action Alternatives within the existing NEC right-of-way. The FRA aggregated this confidential information from the Amtrak general ledger for development of shared infrastructure unit costs.

4.1.2 Amtrak Performance Tracking (APT) Report

The APT system allocates and reports Amtrak financial and performance data by service and by Amtrak business line. The system considers all costs from Amtrak's general ledger and aggregates costs into major activities called cost families that align with the cost areas mentioned in the OIG Report. The APT system allocates costs to the services based on cost directly incurred by those services (e.g., trainmen and enginemen working a particular train on a route) or by an allocation rule (e.g., allocating shared costs by a performance measure such as ridership). To be consistent

³ The FRA used FY 2013 costs in the O&M cost model since they were the most recent complete set of financial data available for the analysis. Amtrak was still in the process of reconciling final costs for FY 2014 during the model development.

with the cost aggregation database, FY 2013 APT data were used in the O&M cost model. The FRA did not use non-infrastructure-related (e.g., train crews and operations, train maintenance, and G&A) financial and performance data for the Acela Express and the Northeast Regional services in the analysis.

4.1.3 National Transit Database (NTD) Reports

The FRA obtained the NTD reports for the 2012 reporting period⁴ for the following agencies for commuter-rail mode only:

- ▶ Massachusetts Bay Transportation Authority (MBTA)
- ▶ Connecticut Department of Transportation (ConnDOT)
- ▶ MTA-Metro-North Railroad (MNR)
- ▶ MTA-Long Island Rail Road (LIRR)
- ▶ New Jersey Transit Corporation (NJ TRANSIT)
- ▶ Southeastern Pennsylvania Transportation Authority (SEPTA)
- ▶ Maryland Transit Administration (MARC)

The NTD reports summarize costs for the following functions: vehicle operations, vehicle maintenance, non-vehicle maintenance, and G&A categories. The reports also convey the number of track miles, annual total vehicle revenue hours, and annual total vehicle revenue miles. The FRA inflated costs to FY 2013 dollars for use in the O&M cost model. Unit costs were developed by the following:

- ▶ Dividing vehicle operations costs by total vehicle revenue hours
- ▶ Dividing vehicle maintenance costs by total vehicle revenue miles
- ▶ Dividing non-vehicle maintenance costs by the number of track miles

4.2 EXISTING PHYSICAL CHARACTERISTICS, SERVICE STATISTICS, AND RIDERSHIP

The FRA assigned five major cost-driver types to costs to derive unit costs: physical characteristics (e.g., track miles, route miles), operating statistics (e.g., revenue hours, revenue miles, and frequency), crew labor hours, fleet requirements, and ridership and ticket revenue. This section details the sources for the existing cost-driver variables. To be consistent with the cost inputs, all cost-driver values reflect physical and service characteristics of the NEC in 2013.

- ▶ Amtrak’s Engineering department provided the following existing physical characteristics:
 - Number of track miles
 - Number of route miles

⁴ At the time of this analysis, NTD reports from 2012 were the most recent year available.

- ▶ The APT report for Acela Express and Northeast Regional services and the Amtrak timetable provided the following existing operating statistics:
 - Annual train revenue miles, by service
 - Annual train frequency, by service
 - Annual train revenue hours, by service
- ▶ The APT report for Acela Express and Northeast Regional services provided the existing crew labor hours and included information on the following:
 - Trainmen crews
 - Enginemen crews
 - Onboard service crews
- ▶ Amtrak's Engineering department provided existing fleet requirements and included the number of trainsets by service.
- ▶ The APT report for Acela Express and Northeast Regional services provided existing ridership and ticket revenue.

4.3 PROJECTED PHYSICAL CHARACTERISTICS, SERVICE STATISTICS, AND RIDERSHIP

The FRA used engineering, service planning, and ridership data sources from the NEC FUTURE models for the projected values of the five major categories of cost-driver variables for the No Action and Action Alternatives.

- ▶ Projected physical characteristics were developed from engineering data:
 - Number of track miles for both the existing NEC right-of-way and new rights-of-way
 - Number of route miles for both the existing NEC right-of-way and new rights-of-way
- ▶ Projected operating statistics were developed from the representative Service Plans:
 - Annual train revenue miles, by service
 - Annual train frequency, by service
 - Annual train revenue hours, by service
- ▶ Projected crew labor hours were derived by multiplying the projected train revenue hours and the ratio between existing crew labor hours to existing revenue hours by service.
- ▶ Projected fleet requirements were developed from representative Service Plans.
- ▶ Projected ridership and ticket revenue were developed from ridership data.

4.4 UNIT COSTS BASED ON NEW HIGH-SPEED INFRASTRUCTURE

Unit costs for maintenance of new high-speed right-of-way and new high-speed multiple-unit equipment were provided by the NEC FUTURE team's experience in developing O&M costs for the CHSRA. High and low estimates are provided for maintenance of infrastructure per track mile and maintenance of equipment per train mile. The O&M cost model utilized the high estimates. The unit costs were derived by the CHSRA in 2014 dollars and were initially converted to 2013 dollars to be consistent with the unit costs derived from Amtrak data. The combined unit costs (both Amtrak- and CHSRA-derived) were subsequently converted to 2014 dollars in the application of the unit costs as described in Section 5.

5. Unit Cost Calculation and Application

This section describes the calculation of O&M unit costs and their application to projected levels of services for the No Action and Action Alternatives. Section 5.1 describes the different types of costs and the process to identify and aggregate them into the appropriate level of detail for a Tier 1 analysis. Section 5.2 reviews the assignment of cost-driver variables to each cost area and functional activity. Section 5.3 discusses the derivation of unit costs. Section 5.4 discusses the application of the unit costs to the projected cost-driver variable values to obtain the projected O&M costs.

While this section describes the calculation of O&M unit costs by dividing costs by cost driver, no actual costs or resulting unit costs are shown because of the proprietary nature of the information. The numeric values are available and were reviewed by parties who signed a non-disclosure agreement.

5.1 COST IDENTIFICATION AND AGGREGATION

This section describes the process of identifying and aggregating O&M costs from the cost aggregation database and the APT reports for the Acela Express and Northeast Regional services.

5.1.1 Infrastructure-related Costs from the Cost Aggregation Database

Table 2 lists the six major cost areas and 23 functional activities that are infrastructure-related costs identified through the cost aggregation database; the table maps each cost area to the cost areas identified in the OIG Report. For this analysis, the FRA included four additional station-related functional activities (i.e., costs associated with baggage & express, first-class lounge, porters, and ticketing functions) as infrastructure-related costs. Costs were aggregated at this level of detail to be consistent with the work done for the NEC Commission in determining groups of costs that could be affected by different cost drivers.

Functional activities associated with electric propulsion, maintenance-of-way, and power directors cost areas generally reflect the cost for maintenance activity on a particular asset class. The exception is electric traction power, which is the actual cost to provide electric propulsion to trains on the NEC.

For the train dispatching cost area, the FRA differentiated costs for blocks and tower operations at major terminals from costs for centralized control and dispatching along the entire NEC. The police cost area has separate functional activities for road costs (e.g., detectives who patrol the right-of-way), yard costs (e.g., patrols at the yard), and station costs (e.g., police located at stations).

Functional activities associated with stations represent the major types of amenities found at Intercity stations as well as station facility maintenance and station cleaning operations. Industry knowledge and experience suggest that for long-range alternatives analysis, ridership is an appropriate cost driver for these functional activities. However, there is no station-by-station ridership information for the Regional rail services in the No Action and Action Alternatives. Thus,

the station costs applied in the O&M cost model are only the Intercity (e.g., modeled on existing Amtrak) portion of the total station O&M cost. These costs were estimated by applying a ratio of Amtrak’s existing train stops and existing passenger on-offs to all NEC operators’ existing train stops and existing passenger on-offs at Amtrak stations.

Table 2 also differentiates between existing infrastructure and new infrastructure for maintenance-of-way. The FRA categorized the new infrastructure maintenance-of-way by costs associated with additional track along the existing NEC mainline, and by cost associated with new alignment track.

Table 2: Cost Areas and Functional Activities Included from the Cost Aggregation Database

Cost Area	OIG Report Cost Area	Functional Activity
EXISTING INFRASTRUCTURE		
Electric Propulsion	Energy	Electric Traction Power
		Frequency Converter Maintenance
Maintenance-of-Way	Railroad	Bridges
		Communication Systems
		Electric Traction
		Equipment
		Facilities
		Signal & Interlocking
Police – Road, Yard, & Station	Railroad	Road
		Yard
Power Directors	Railroad	Power Directors & Load Dispatchers
Train Dispatching	Railroad	Blocks & Towers
		Control & Dispatch
Police – Road, Yard, & Station	Railroad	Station Police
Station Maintenance & Services	Stations	Baggage & Express
		First Class Lounge
		Porters
		Station Maintenance
		Station Operations
		Stationmasters & Ushers
		Ticketing
Utilities		
NEW INFRASTRUCTURE		
Maintenance-of-Way	Railroad	Existing Alignment – New Track
Maintenance-of-Way – New		New Alignment – Track

Source: NEC FUTURE team, 2015

5.1.2 For this analysis, the infrastructure-related costs were aggregated at the level of detail suggested in Table 2 (i.e., corridor-wide by cost area and by functional activity). The geographic or location-based information from the cost aggregation database was only utilized to determine the NEC territory for which representative Service Plans for the No Action and Action Alternatives applied. The analysis excluded infrastructure-related costs for the existing New Haven to Springfield branch line as well as the Harrisburg line west of Philadelphia. These costs were developed for planning

purposes only, based on the representative Service Plans. Transportation, Equipment, and G&A Costs from the APT Report

In addition to infrastructure-related costs, train crews and operations, train maintenance, and G&A costs needed to be 1) identified and 2) mutually exclusive to the costs included from the cost aggregation database. Table 3 lists nine additional cost areas and 30 functional activities from the APT report that are transportation, equipment, sales and marketing, and national operations costs. The table also maps the APT report cost areas to the cost areas mentioned in the OIG Report. The FRA aggregated these costs by cost area, functional activity, and by existing service (e.g., Acela Express and Northeast Regional).

Table 3: Cost Areas and Functional Activities Included from the APT Report

Cost Area	OIG Report Cost Area	Functional Activity
Maintenance of Equipment (MoE)	Train Maintenance	Turnaround
		Locomotive Maintenance
		Car Maintenance
		MoE Support
		MoE Multiple Functions
		High-speed Rail Maintenance
		Backshop
Onboard Services (OBS)	Train Crews	Crew
		Supplies – Food & Beverage (F&B)
		Commissary/ Management - F&B
		Support
Trainmen & Enginemen (T&E)	Train Crews	Trainmen Crew
		Enginemen Crew
		Other T&E Activity
		T&E Support
Yard	Train Crews	Train & Equipment
		Equipment Moves
	Railroad	Yard Direct
		Terminal Rent/ Yard Services
Fuel	Energy	Train Fuel (Diesel)
Other Transportation Ops	Railroad	Transportation – Multiple Functions
		Transportation Support
Sales & Marketing	G&A	Sales
		Information & Reservations
		Marketing
Police, Security, Environmental	G&A	National Police – Special Ops.
		Emergency Mgmt. & Corp. Security
		Environmental & Safety
G&A	G&A	G&A Fixed
		G&A Variable

Source: NEC FUTURE team, 2015

Functional activities associated with the maintenance of equipment (MoE) cost area reflect the cost associated with turnaround servicing (e.g., train cleaning) as well as costs associated with asset-specific maintenance activities (e.g., locomotive and car maintenance). The APT report also

distinguishes between MoE support costs (e.g., material handling and fleet engineering) and MoE multiple function costs that support more than one MoE maintenance activity. The FRA included costs associated with maintaining current Acela Express equipment in the high-speed rail maintenance functional activity. Current Acela MoE costs were applied to calibrate the O&M cost model based on Amtrak experience and to project the O&M cost for the No Action Alternative (since no new fleet is assumed in that alternative). Finally, the FRA captured costs associated with major overhauls and repairs in the backshop functional activity.

Functional activities for the trainmen and enginemen (T&E), onboard service (OBS), and yard cost areas generally reflect crew requirements and the support to provide crew assignments and dispatch crews. Also included in the OBS cost area were costs for food and beverage supplies as well as costs for commissary operation and management.

The fuel cost area was included in the O&M cost model since this is the cost for diesel train fuel. Functional activities for the other transportation operations cost area represent costs for transportation-related administrative functions (e.g., T&E, OBS, and passenger services) and costs for multiple transportation-related activity supervision and support.

The G&A costs as defined by the OIG Report include corporate-level and sales and marketing activities. Amtrak further categorizes these G&A costs into the sales and marketing cost area, police, security, and environment cost area, and a G&A cost area.

The sales and marketing cost-area functional activities distinguish between costs associated with sales, information and reservations, and marketing activities. The police, security, and environmental cost-area functional activities distinguish between costs for special operations police (who are not detectives or station and yard patrolmen), corporate security, and corporate environmental and safety initiative implementation.

The G&A cost area includes corporate administration, general centralized services (e.g., human resources, labor relations), and financial centralized services (e.g., payables, receivables, and payroll) costs. The majority of G&A costs are considered fixed costs (i.e., the costs will not vary with a change in service). The variable G&A cost are costs associated with the treasury mandatory function. This function includes various finance department costs, the largest of which are associated with passenger credit card transactions and insurance premiums.

5.2 SELECTION OF COST DRIVERS

This section introduces the cost drivers used to derive unit costs. These cost drivers—assembled from the various inputs described in Section 4.2—were transformed to meet the requirements of this analysis, and were assigned to costs at the functional activity level. In addition to deriving unit costs, the FRA used these cost drivers to allocate infrastructure-related costs to the various Intercity and Regional/Commuter services. In several instances, the cost driver used to derive the unit cost was different from the cost driver (i.e., allocation driver) that was used to allocate infrastructure-related costs across the NEC FUTURE service types. Cost-driver and allocation-driver assignments

were based on industry knowledge and experience with changes in O&M costs as a result of changes in cost-driver values.

5.2.1 Cost Drivers and Allocation Drivers for Infrastructure-Related Costs

Since infrastructure-related O&M costs were aggregated by territory regardless of the service operated, those costs required an assignment of a cost driver as well as an allocation driver. The unit cost resulting from the cost-driver element represents the change in O&M cost per change in service. The allocation driver was selected as a method to distribute the costs on a consistent basis across all alternatives to the different NEC FUTURE service types.

Functional activities associated with electric propulsion and power directors were assigned electrified train miles for both the cost driver and the allocation driver. Electrified train miles were derived from existing train miles based on the existing electrified service across the NEC. This cost driver was derived to better associate electric propulsion costs to actual consumption by service (e.g., currently the MBTA does not run electrified service on the NEC).

Maintenance-of-way costs are driven by inspection and testing activities on the different infrastructure asset classes. Much of this activity is done on a calendar basis rather than based on the activity level along the corridor. As such, the number of track miles was assigned as the cost driver for all maintenance-of-way functional activities. Existing track miles pertain to existing maintenance-of-way costs. Any additional track miles along the NEC or new track miles off-corridor were assigned those respective track mile values. The allocation driver was different for all functional activities since it needed to be a service-related statistic to be able to allocate costs to each of the services. Costs associated with maintaining bridges, equipment, facilities, and track assets were allocated on the basis of train miles to reflect the share of usage of the infrastructure corridor-wide. Communication systems and signal and interlocking costs were allocated on the basis of train frequency to reflect the share of occupancy on the network. Electric traction maintenance costs were allocated on the basis of electrified train miles to reflect the electric propulsion consumption by user.

Road and yard police functional activity costs are driven by patrols that do not vary with increases in service but do vary with increases in territory (in distance covered, not the number of tracks). Thus, police road and yard costs are driven by total route miles. These costs were assigned train miles as the allocation driver to reflect the share of usage of the infrastructure corridor-wide.

Train dispatching costs are driven by the amount of territory managed (not necessarily on the level of activity on the NEC). Thus, track miles are assigned as the cost driver for dispatching costs. These costs were allocated to the services on the basis of frequency to reflect the share of occupancy on the network.

Stations costs, including station police costs, are driven by passenger activity level at the station. Thus, ridership was assigned as the cost driver. As mentioned in Section 5.1.1, since only the Intercity portion of station costs was included, Intercity ridership was used as the allocation driver.

Table 4 summarizes the assignment of cost driver and allocation driver to each infrastructure-related functional activity.

Table 4: Infrastructure-related Functional Activity Cost Drivers and Allocation Drivers

Cost Area	Functional Activity	Cost Driver	Allocation Driver
EXISTING INFRASTRUCTURE			
Electric Propulsion	Electric Traction Power	Electrified Train Miles	Electrified Train Miles
	Freq. Converter Maintenance	Electrified Train Miles	Electrified Train Miles
Maintenance-of-Way	Bridges	Existing Track Miles	Train Miles
	Comm. Systems	Existing Track Miles	Frequency
	Electric Traction	Existing Track Miles	Electrified Train Miles
	Equipment	Existing Track Miles	Train Miles
	Facilities	Existing Track Miles	Train Miles
	Signal & Interlocking	Existing Track Miles	Frequency
	Track	Existing Track Miles	Train Miles
Police – Road, Yard, & Station	Road	Total Route Miles	Train Miles
	Yard	Total Route Miles	Train Miles
Power Directors	Power Directors & Load Dispatchers	Electrified Train Miles	Electrified Train Miles
Train Dispatching	Blocks & Towers	Track Miles	Frequency
	Control & Dispatch	Track Miles	Frequency
Police – Road, Yard, & Station	Station Police	NEC Intercity Ridership	NEC Intercity Ridership
Station Maintenance & Services	Baggage & Express	NEC Intercity Ridership	NEC Intercity Ridership
	First Class Lounge	NEC Intercity Ridership	NEC Intercity Ridership
	Porters	NEC Intercity Ridership	NEC Intercity Ridership
	Station Maintenance	NEC Intercity Ridership	NEC Intercity Ridership
	Station Operations	NEC Intercity Ridership	NEC Intercity Ridership
	Stationmasters & Ushers	NEC Intercity Ridership	NEC Intercity Ridership
	Ticketing	NEC Intercity Ridership	NEC Intercity Ridership
	Utilities	NEC Intercity Ridership	NEC Intercity Ridership
NEW INFRASTRUCTURE			
Maintenance-of-Way	Existing Alignment – New Track	New Track Miles	Train Miles
Maintenance-of-Way – New	New Alignment – Track	New Track Miles	Train Miles

Source: NEC FUTURE team, 2015

5.2.2 Cost Drivers for Intercity Transportation, Equipment, and G&A Costs

For costs from the APT report, the FRA assigned a cost driver to each functional activity and each existing service (i.e., Acela Express and Northeast Regional).

Both MoE and yard functional activity costs are largely driven by the equipment requirements to provide the level-of-service specified in the representative Service Plans. For MoE, many maintenance activities are calendar based and costs depend on the number of trainsets needing periodic maintenance. The exception is turnaround servicing cost, which does vary with the frequency of service. Costs associated with yard activity are driven by the number trainsets needing assembly and movement to and from the yard at the beginning and end of the day.

Crew-based costs for onboard services and T&E are driven by the labor hours worked, which is a function of the number of train revenue hours. Projected labor hours for each crew position were derived from the ratio of existing labor hours by position to train revenue hours by service. Food and beverage and commissary costs are driven as a percentage of the food and beverage revenue.

Fuel and other transportation operations costs are driven by train miles to reflect the general share of usage of the corridor.

Sales and marketing, police, security, and environmental, and G&A variable costs are driven either by Intercity ridership or by ticket revenue. Generally, costs associated with passenger interaction (e.g., information and reservations, national police, emergency management and corporate security, and environmental and safety costs) are driven by Intercity ridership. Costs associated with activities related to financial performance (e.g., sales, marketing, and G&A variable costs) are driven by ticket revenue.

Table 5 summarizes the assignment of cost drivers by service for each functional activity for transportation, equipment, and G&A costs. The cost drivers by functional activity are the same for the existing NEC Intercity services. This is true when deriving existing unit costs only. Section 5.3.3 and Section 5.3.4 discuss the differences in projected unit costs by service.

Table 5: Transportation, Equipment, and National Functional Activity Cost Drivers by Service

Cost Area	Functional Activity	Existing NEC Intercity Service Cost Driver
Maintenance of Equipment (MoE)	Turnaround	Frequency
	Locomotive Maintenance	Train Sets
	Car Maintenance	Train Sets
	MoE Support	Train Sets
	MoE Multiple Functions	Train Sets
	HSR Maintenance	Train Sets
	Backshop	Train Sets
Onboard Services	Crew	OBS Labor Hours
	Supplies - F&B	% of F&B Revenue
	Commissary/Management - F&B	% of F&B Revenue
	Support	OBS Labor Hours
Trainmen & Enginemen (T&E)	Trainmen Crew	Trainmen Labor Hours
	Enginemen Crew	Enginemen Labor Hours
	Other T&E Activity	T&E Labor Hours
	Support	T&E Labor Hours
Yard	Train & Equipment	Train Sets
	Equipment Moves	Train Sets
	Yard Direct	Train Sets
	Terminal Rent/Yard Services	Train Sets
Fuel	Train Fuel (Diesel)	Train Miles
Other Transportation Ops	Transportation – Multiple Functions	Train Miles
	Transportation Support	Train Miles

Table 5: Transportation, Equipment, and National Functional Activity Cost Drivers by Service (continued)

Cost Area	Functional Activity	Existing NEC Intercity Service Cost Driver
Sales & Marketing	Sales	Ticket Revenue
	Information & Reservations	NEC Intercity Ridership
	Marketing	Ticket Revenue
Police, Security, Environmental	National Police - Special Ops	NEC Intercity Ridership
	Emergency Mgmt & Corp Security	NEC Intercity Ridership
	Environmental & Safety	NEC Intercity Ridership
G&A	G&A Fixed	Fixed
	G&A Variable	Ticket Revenue

Source: NEC FUTURE team, 2015

Cost drivers for transportation-related costs associated with the NEC FUTURE Regional service are governed by the NTD reports for each of the existing commuter-rail operators on the NEC (see Section 4.1.3 for derivation).

5.2.3 Existing Cost-Driver Values

Table 6 lists the various cost drivers utilized for this analysis and shows the existing (2013) cost-driver values for existing Intercity services (e.g., Acela Express and Northeast Regional) and for all Regional/Commuter services.

Table 6: Existing Cost-Driver Values

Statistic	INTERCITY			REGIONAL	NEC Total
	Acela Express	Northeast Regional	Intercity Total	All Services	
Annual Train Revenue Hours	50,839	101,637	152,476	314,276	466,752
Total Train Trips	9,515	16,429	25,944	204,345	230,289
Train Sets	20	25	45	—	45
Trainmen labor hours	164,621	594,121	758,742	—	758,742
Enginemen labor hours	84,853	217,197	302,050	—	302,050
Trainmen and Enginemen labor hours	249,475	850,925	1,100,400	—	1,100,400
OBS labor hours	234,068	174,423	408,491	—	408,491
Annual Train Revenue Miles	3,313,867	5,656,296	8,970,163	10,114,260	19,084,423
Electrified Train Miles	3,313,867	5,656,296	8,970,163	5,699,152	14,669,314
Ticket Revenue	\$530,820,821	\$568,744,563	\$1,099,565,384	—	\$1,099,565,384
Passenger Ridership	3,343,143	8,044,216	11,387,359	—	11,387,359

Source: NEC FUTURE team, 2015

5.3 DERIVATION OF UNIT COSTS

This section discusses the process used to derive the unit cost by functional activity, and examines how the unit costs were adjusted due to changes in operations, changes in amenities, or changes in cost indices.

5.3.1 Unit Cost Calculation

Unit costs are calculated by dividing the O&M cost associated with a cost area and functional activity by the cost driver value, as shown in the sample equation below:

$$\text{Track Maintenance Costs} \div \text{Number of Track Miles} = \text{Unit Cost per Track Mile}$$

$$\$50,000,000 \div 1,000 \text{ track miles} = \$50,000 \text{ per track mile}$$

The FRA derived the unit costs for the following cost types:

- ▶ **Operations on shared infrastructure:** general railroad infrastructure costs on infrastructure segments hosting both Intercity and Regional rail services.
- ▶ **Operations on new high-speed segments:** costs that result from maintenance of new segments hosting high-speed operations (affecting some of proposed services for some of the alternatives.)
- ▶ **Transportation operations costs:** train and engine crew costs for activities unique to each operator and each service.
- ▶ **Regional rail specific transportation operations costs:** costs associated with Regional rail operations for vehicle operations, vehicle maintenance, non-vehicle maintenance, and G&A costs.

5.3.2 Unit Cost Expansion/ Reduction Factors

For projected future services, the FRA applied unit cost expansion/reduction factors to address anticipated changes resulting from more-frequent service or from the implementation of next generation technologies. Table 7 lists the expansion/ reduction factors and the corresponding cost area and functional activity that they apply to. The expansion factors for maintenance-of-way were based on insights from Amtrak Engineering staff based on experience in the implementation of Amtrak's capital program and operational experience from track possessions. More-frequent service will mean fewer and shorter available maintenance windows between trains. The reduction factor for Station Maintenance and Services were based on the expectation that passenger handling costs associated with the NEC FUTURE alternatives decrease with the implementation of automated passenger gates (similar to technology being installed at airports) and more vertical circulation facilities (e.g., elevators and escalators).

Table 7: Unit Cost Expansion/ Reduction Factor

Cost Area	Functional Activity	Cost Expansion/ Reduction Factor	Rationale
Maintenance-of-Way	Communications Systems	1.25	More-frequent service; fewer and shorter available maintenance windows
	Signal & Interlocking	1.25	
	Track	1.25	
Station Maintenance and Services	First Class Lounge	0.7	More extensive use of self-service ticketing and passenger access
	Stationmasters and Ushers	0.7	

Source: NEC FUTURE team, 2015

The expansion/ reduction factor was multiplied with the associated unit cost to produce the adjusted projected unit cost, as shown in the sample equation below:

$$\text{Unit Cost per Track Mile} \times \text{Expansion Factor} = \text{Projected Unit Cost per Track Mile}$$

$$\$50,000 \text{ per track mile} \times 1.25 = \$62,500 \text{ per track mile}$$

5.3.3 Projected Maintenance of Equipment Unit Costs by Service

For projections of MoE costs, the analysis used the unit costs for new high-performance equipment estimated for the CHSRA. Unlike the unit cost derived from existing costs, the FRA projected the new high-performance equipment unit cost based on train miles instead of the number of trainsets. Additionally, the electric multiple unit trainsets for NEC FUTURE are projected to be used for Intercity-Express and Metropolitan services only. The Intercity-Corridor equipment will resemble existing Northeast Regional equipment. This is consistent with the *Service Plans and Train Equipment Options Technical Memorandum*.

Table 8 shows how the cost drivers are associated with the new Intercity services and indicate which unit cost will be applied to project equipment-related O&M costs. The Intercity-Express and Metropolitan service applied the CHSRA MoE unit costs, which were applied per train mile. For Intercity-Corridor service, units are based on existing Northeast Regional service, which are applied per trainset.

Table 8: Application of Maintenance of Equipment Projected Unit Costs by Service

Functional Activity	Application to NEC FUTURE Services		
	Intercity-Express	Metropolitan	Intercity-Corridor
Turnaround	Frequency	Frequency	Frequency
Locomotive Maintenance	Train Miles	Train Miles	Train Sets
Car Maintenance	Train Miles	Train Miles	Train Sets
MoE Support	Train Miles	Train Miles	Train Sets
MoE Multiple	Train Miles	Train Miles	Train Sets
HSR Maintenance	Train Miles	Train Miles	Train Sets
Backshop	Train Miles	Train Miles	Train Sets

Source: NEC FUTURE team, 2015

5.3.4 Projected Onboard Services Unit Costs by Service

The FRA assumes that the new Intercity-Express service includes onboard services characteristics that are similar to the existing Acela Express service. These services comprise food and beverage, commissary, and onboard service crew costs. Therefore, the FRA applied Acela Express onboard services unit costs for the onboard services functional activities for the new Intercity-Express service.

For the Intercity-Corridor and Metropolitan service types, the FRA assumed food and beverage amenities such as vending machines or a third-party/contracted operation. For this analysis, the FRA assumed that revenues roughly equal (or perhaps exceed) costs; thus, these costs would not

have a material impact on the overall O&M costs of these service types. Estimates of these costs were therefore excluded from this analysis.

5.3.5 Calculation of Unit Costs for New High-Speed Infrastructure and Equipment

The FRA first de-inflated the unit costs for new high-speed infrastructure to 2013 dollars using the Association of American Railroads index to be consistent with other data sources used in the analysis. The unit costs were also converted from California labor rates to Philadelphia MSA labor rates (which represent a median wage rate for the Northeast Region) using the Bureau of Labor Statistics transportation wage index.

5.4 APPLICATION OF UNIT COSTS TO PROJECTED COST DRIVER VALUES

Once all infrastructure-related and transportation- and equipment-related unit costs were calculated and adjusted to a projected unit cost, these unit costs were applied to the projected cost-driver values for the No Action and Action Alternatives to obtain the projected O&M costs for each alternative.⁵ A sample calculation is shown in the equation below:

$$\begin{aligned} \text{Projected Unit Cost per Track Mile} \times \text{Projected Num. of Track Miles} &= \text{Projected Track Maint. Costs} \\ \$62,500 \text{ per track mile} \times 2,000 \text{ track miles} &= \$125,000,000 \end{aligned}$$

For shared infrastructure costs, the unit cost is accompanied by an allocation driver. The projected cost that resulted from applying the unit cost to the projected cost driver value was allocated to the Intercity services and Regional/Commuter operators using the designated allocation driver. The cost driver and allocation driver were the same for certain functional activities.

The FRA then inflated projected O&M costs to 2014 dollars using the Association of American Railroads index to ensure consistent reporting of cost data across the NEC FUTURE analysis.

5.4.1 Fare Strategy

The ridership model run for 2013 base trips was performed using the current (i.e., today's) fares, to accurately match existing ridership. Initial model runs were consistent with current fares, but because the future alternatives include new markets, the FRA calculated distance-based fare equations based on current fares for three types of rail trips—including trips entirely south of New York, trips north of New York, and trips through New York—since there are market-based differences in the pricing structures for these trips today.

The O&M costs associated with these existing fare scenarios were substantially lower than the associated revenues. Therefore, multiple fare discounts were tested for the Intercity-Corridor service. Keeping the Intercity-Express fares at the existing level while reducing the Intercity-Corridor fares by 30 percent was the second set of scenarios examined to create a range of ridership numbers for each Action Alternative. This set of fare policies is not intended as a fare-maximizing or

⁵ For a complete description of the alternatives, see the NEC FUTURE Service Planning Technical Memorandum

ridership-maximizing analysis, but is intended to demonstrate that Intercity service operates profitably over multiple fare structures and to provide a range of ridership results.

Table 9 shows the projected cost-driver values for Intercity services as well as for all Regional/Commuter services for the No Action and Action Alternatives.

Table 9: Projected Cost-Driver Values

Alternative	Statistic	INTERCITY				REGIONAL	NEC Total
		Intercity-Express	Intercity-Corridor	Metropolitan	Intercity Total	All Commuters	
No Action	Annual Train Revenue Hours	50,839	101,637		152,476	314,276	466,752
	Total Train Trips	9,515	16,429		25,944	204,345	230,289
	Train Sets	20	25		45	—	45
	Trainmen labor hours	164,621	594,121		758,742	—	758,742
	Enginemen labor hours	84,853	217,197		302,050	—	302,050
	Trainmen and Enginemen labor hours	249,475	850,925		1,100,400	—	1,100,400
	OBS labor hours	234,068	174,423		408,491	—	408,491
	Annual Train Revenue Miles	3,313,867	5,656,296		8,970,163	10,114,260	19,084,423
	Electrified Train Miles	3,313,867	5,656,296		8,970,163	5,699,152	14,669,314
	Ticket Revenue	\$944,340,615	\$876,071,140		\$1,820,411,754	—	\$1,820,411,754
	Ridership	5,740,060	13,268,306		19,008,365	—	19,008,365
1	Annual Train Revenue Hours	73,460	107,411	119,813	300,684	310,256	610,939
	Total Train Trips	16,200	22,010	30,530	68,740	384,180	452,920
	Train Sets	23	15	28	66	—	66
	Trainmen labor hours	237,870	627,874	700,366	1,566,111	—	1,566,111
	Enginemen labor hours	122,609	229,536	256,037	608,182	—	608,182
	Trainmen and Enginemen labor hours	360,479	857,410	956,404	2,174,293	—	2,174,293
	OBS labor hours	338,217	184,332	205,614	728,164	—	728,164
	Annual Train Revenue Miles	4,014,000	4,664,700	5,694,200	14,372,900	16,476,705	30,849,605
	Electrified Train Miles	4,014,000	4,664,700	5,694,200	14,372,900	15,863,473	30,236,373
	Ticket Revenue	\$651,796,698	\$580,660,645	\$805,432,508	\$2,037,889,852	\$—	\$2,037,889,852
	Ridership	4,285,763	11,878,772	16,477,006	32,641,541	—	32,641,541

Table 9: Projected Cost-Driver Values (continued)

Alternative	Statistic	INTERCITY				REGIONAL	NEC Total
		Intercity-Express	Intercity-Corridor	Metropolitan	Intercity Total	All Commuters	
2	Annual Train Revenue Hours	126,630	81,484	256,050	464,164	282,540	746,704
	Total Train Trips	35,400	22,010	71,000	128,410	447,735	576,145
	Train Sets	44	19	65	128	—	128
	Trainmen labor hours	410,039	476,318	1,496,744	2,383,101	—	2,383,101
	Enginemen labor hours	211,353	174,131	547,174	932,658	—	932,658
	Trainmen and Enginemen labor hours	621,392	650,449	2,043,917	3,315,759	—	3,315,759
	OBS labor hours	583,018	139,838	439,416	1,162,271	—	1,162,271
	Annual Train Revenue Miles	11,274,000	4,541,160	18,320,130	34,135,290	15,459,255	49,594,545
	Electrified Train Miles	11,274,000	4,541,160	18,320,130	34,135,290	14,846,023	48,981,313
	Ticket Revenue	\$1,000,331,339	\$351,731,264	\$1,134,616,979	\$2,486,679,582	\$—	\$2,486,679,582
	Ridership	6,459,220	7,244,599	23,369,675	37,073,494	—	37,073,494
3.1	Annual Train Revenue Hours	169,310	81,484	316,388	567,182	317,110	884,292
	Total Train Trips	53,400	22,010	87,330	162,740	493,620	656,360
	Train Sets	35	19	79	133	—	133
	Trainmen labor hours	548,241	476,318	1,849,452	2,874,011	—	2,874,011
	Enginemen labor hours	282,589	174,131	676,116	1,132,835	—	1,132,835
	Trainmen and Enginemen labor hours	830,830	650,449	2,525,567	4,006,846	—	4,006,846
	OBS labor hours	779,521	139,838	542,964	1,462,323	—	1,462,323
	Annual Train Revenue Miles	19,582,800	4,195,390	25,641,295	49,419,485	21,500,970	70,920,455
	Electrified Train Miles	19,582,800	4,195,390	25,641,295	49,419,485	20,887,738	70,307,223
	Ticket Revenue	\$1,127,142,811	\$304,727,513	\$1,209,080,131	\$2,640,950,455	\$—	\$2,640,950,455
	Ridership	7,126,986	6,273,105	24,890,062	38,290,152	—	38,290,152

Table 9: Projected Cost-Driver Values (continued)

Alternative	Statistic	INTERCITY				REGIONAL	NEC Total
		Intercity-Express	Intercity-Corridor	Metropolitan	Intercity Total	All Commuters	
3.2	Annual Train Revenue Hours	171,890	81,484	323,133	576,507	333,588	910,095
	Total Train Trips	53,400	22,010	87,330	162,740	493,620	656,360
	Train Sets	35	19	79	133	—	133
	Trainmen labor hours	556,595	476,318	1,888,880	2,921,793	—	2,921,793
	Enginemen labor hours	286,895	174,131	690,529	1,151,555	—	1,151,555
	Trainmen and Enginemen labor hours	843,490	650,449	2,579,409	4,073,348	—	4,073,348
	OBS labor hours	791,399	139,838	554,539	1,485,777	—	1,485,777
	Annual Train Revenue Miles	20,213,100	4,012,920	22,825,790	47,051,810	21,965,520	69,017,330
	Electrified Train Miles	20,213,100	4,012,920	22,825,790	47,051,810	21,352,288	68,404,098
	Ticket Revenue	\$1,236,660,015	\$297,539,753	\$1,180,560,954	\$2,714,760,721	\$—	\$2,714,760,721
	Ridership	7,837,418	6,216,863	24,666,908	38,721,189	—	38,721,189
3.3	Annual Train Revenue Hours	176,510	81,484	316,116	574,110	333,588	907,698
	Total Train Trips	52,800	22,010	75,000	149,810	493,620	643,430
	Train Sets	35	19	79	133	—	133
	Trainmen labor hours	571,555	476,318	1,847,861	2,895,734	—	2,895,734
	Enginemen labor hours	294,606	174,131	675,534	1,144,270	—	1,144,270
	Trainmen and Enginemen labor hours	866,161	650,449	2,523,395	4,040,005	—	4,040,005
	OBS labor hours	812,670	139,838	542,497	1,495,005	—	1,495,005
	Annual Train Revenue Miles	19,845,000	4,353,720	21,160,840	45,359,560	22,659,495	68,019,055
	Electrified Train Miles	19,845,000	4,353,720	21,160,840	45,359,560	22,046,263	67,405,823
	Ticket Revenue	\$1,191,720,147	\$355,609,145	\$1,211,753,106	\$2,759,082,397	\$—	\$2,759,082,397
	Ridership	7,553,380	7,310,935	24,912,319	39,776,634	—	39,776,634

Table 9: Projected Cost-Driver Values (continued)

Alternative	Statistic	INTERCITY				REGIONAL	NEC Total
		Intercity-Express	Intercity-Corridor	Metropolitan	Intercity Total	All Commuters	
3.4	Annual Train Revenue Hours	177,780	81,484	320,885	580,149	317,110	897,259
	Total Train Trips	53,400	22,010	86,620	162,030	493,620	655,650
	Train Sets	35	19	79	133	—	133
	Trainmen labor hours	575,668	476,318	1,875,737	2,927,723	—	2,927,723
	Enginemen labor hours	296,725	174,131	685,725	1,156,581	—	1,156,581
	Trainmen and Enginemen labor hours	872,393	650,449	2,561,462	4,084,304	—	4,084,304
	OBS labor hours	818,517	139,838	550,681	1,509,037	—	1,509,037
	Annual Train Revenue Miles	19,393,200	4,353,720	19,894,555	43,641,475	22,194,945	65,836,420
	Electrified Train Miles	19,393,200	4,353,720	19,894,555	43,641,475	21,581,713	65,223,188
	Ticket Revenue	\$1,123,015,860	\$309,477,714	\$1,217,944,554	\$2,650,438,128	—	\$2,650,438,128
	Ridership	7,106,260	6,379,757	25,107,429	38,593,446	—	38,593,446

Source: NEC FUTURE team, 2015

6. Results

6.1 SUMMARY OF REVENUE, O&M COSTS, AND NET CONTRIBUTION

For the No Action and Action Alternatives, the results are shown in 2014 dollars for each service and are organized as follows:

- ▶ Revenues (includes ticket and food and beverage for appropriate services)
- ▶ O&M costs:
 - Shared infrastructure costs
 - Transportation operations costs
 - Sales & Marketing, National Operations costs
 - G&A costs
- ▶ Net Contribution (revenue minus O&M costs)

Recognizing an interest in determining if the Intercity services in the No Action and Action Alternatives covered the full cost of operations from passenger revenues, this analysis included all projected O&M costs to determine the net contribution. This allowed for an evaluation of the complete picture of revenues and costs, and the resulting net contributions by each alternative. The FRA already accounted for equipment cost recovery in the capital cost estimates. Table 10 through Table 16 present the summary results of revenue, O&M costs, and net contribution for the No Action and Action Alternatives.

6.2 CONTRIBUTION ANALYSIS ACROSS ALTERNATIVES

Table 17 compares the revenue, O&M cost, and net contribution by service type across the No Action and Action Alternatives. For all alternatives, total revenues exceed total costs for the proposed Intercity service types (e.g., Intercity-Express, Metropolitan, and Intercity-Corridor services).

Table 10: No Action Alternative O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$927,000,000	—	\$899,400,000	\$1,826,400,000	—	\$1,826,400,000
Food & Beverage Revenue	\$37,100,000	—	\$36,000,000	\$73,100,000	—	\$73,100,000
<i>(Assumed 4% of ticket revenue)</i>						
TOTAL REVENUE	\$964,100,000	—	\$935,400,000	\$1,899,500,000	—	\$1,899,500,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$18,300,000	—	\$31,200,000	\$49,500,000	\$31,400,000	\$80,900,000
Maintenance-of-Way	\$29,700,000	—	\$50,700,000	\$80,400,000	\$107,800,000	\$188,200,000
Maintenance-of-Way - New	—	—	—	—	—	—
* Police - Road, Yard, & Station	\$5,400,000	—	\$11,600,000	\$17,000,000	\$3,800,000	\$20,800,000
Power Directors	\$1,500,000	—	\$2,500,000	\$4,000,000	\$2,500,000	\$6,500,000
* Train Dispatching	\$1,800,000	—	\$3,000,000	\$4,800,000	\$25,700,000	\$30,500,000
* Station Maintenance & Services	\$38,100,000	—	\$90,400,000	\$128,500,000	—	\$128,500,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$494,100,000	\$494,100,000
* Maintenance of Equipment	\$72,600,000	—	\$101,200,000	\$173,800,000	—	\$173,800,000
* Onboard Services	\$32,000,000	—	\$18,700,000	\$50,700,000	—	\$50,700,000
* Trainmen & Enginemen	\$18,600,000	—	\$59,300,000	\$77,900,000	—	\$77,900,000
* Yard	\$6,600,000	—	\$19,100,000	\$25,700,000	—	\$25,700,000
* Fuel	\$200,000	—	\$1,800,000	\$2,000,000	—	\$2,000,000
* Other Transportation Ops	\$5,900,000	—	\$13,700,000	\$19,600,000	—	\$19,600,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$58,600,000	—	\$48,200,000	\$106,800,000	—	\$106,800,000
* Police, Security, Environmental	\$7,600,000	—	\$10,000,000	\$17,600,000	—	\$17,600,000
G&A Costs						
* G&A	\$61,400,000	—	\$86,900,000	\$148,300,000	—	\$148,300,000
TOTAL O&M COSTS	\$358,300,000	—	\$548,300,000	\$906,600,000	\$665,300,000	\$1,571,900,000
<i>* = Indicates above-the-rail (ATR) cost area</i>						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$605,800,000	—	\$387,100,000	\$992,900,000		

Source: NEC FUTURE team, 2015

Table 11: Alternative 1 O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$773,000,000	\$795,700,000	\$573,700,000	\$2,142,400,000	—	\$2,142,400,000
Food & Beverage Revenue (Assumed 4% of ticket revenue)	\$30,900,000	—	—	\$30,900,000	—	\$30,900,000
TOTAL REVENUE	\$803,900,000	\$795,700,000	\$573,700,000	\$2,173,300,000	—	\$2,173,300,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$31,400,000	\$43,000,000	\$34,600,000	\$109,000,000	\$46,200,000	\$155,200,000
Maintenance-of-Way	\$38,200,000	\$54,600,000	\$43,200,000	\$136,000,000	\$115,900,000	\$251,900,000
Maintenance-of-Way - New	\$4,300,000	\$5,900,000	\$4,700,000	\$14,900,000	\$6,800,000	\$21,700,000
* Police - Road, Yard, & Station	\$5,200,000	\$13,300,000	\$9,800,000	\$28,300,000	\$3,100,000	\$31,400,000
Power Directors	\$2,500,000	\$3,400,000	\$2,800,000	\$8,700,000	\$3,700,000	\$12,400,000
* Train Dispatching	\$1,600,000	\$3,100,000	\$2,200,000	\$6,900,000	\$23,600,000	\$30,500,000
* Station Maintenance & Services	\$33,700,000	\$110,600,000	\$79,700,000	\$224,000,000	—	\$224,000,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$552,000,000	\$552,000,000
* Maintenance of Equipment	\$36,200,000	\$50,200,000	\$91,100,000	\$177,500,000	—	\$177,500,000
* Onboard Services	\$33,900,000	—	—	\$33,900,000	—	\$33,900,000
* Trainmen & Enginemen	\$26,900,000	\$73,000,000	\$65,400,000	\$165,300,000	—	\$165,300,000
* Yard	\$7,600,000	\$9,200,000	\$11,500,000	\$28,300,000	—	\$28,300,000
* Fuel	\$400,000	\$600,000	\$2,000,000	\$3,000,000	—	\$3,000,000
* Other Transportation Ops	\$10,100,000	\$13,900,000	\$15,200,000	\$39,200,000	—	\$39,200,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$49,500,000	\$76,100,000	\$35,100,000	\$160,700,000	—	\$160,700,000
* Police, Security, Environmental	\$6,700,000	\$22,100,000	\$8,800,000	\$37,600,000	—	\$37,600,000
G&A Costs						
* G&A	\$42,800,000	\$59,700,000	\$51,100,000	\$153,600,000	—	\$153,600,000
TOTAL O&M COSTS	\$331,000,000	\$538,700,000	\$457,200,000	\$1,326,900,000	\$751,300,000	\$2,078,200,000
* = Indicates above-the-rail (ATR) cost area						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$472,900,000	\$257,000,000	\$116,500,000	\$846,400,000		

Source: NEC FUTURE team, 2015

Table 12: Alternative 2 O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$984,300,000	\$1,117,100,000	\$346,300,000	\$2,447,700,000	—	\$2,447,700,000
Food & Beverage Revenue <i>(Assumed 4% of ticket revenue)</i>	\$39,400,000	—	—	\$39,400,000	—	\$39,400,000
TOTAL REVENUE	\$1,023,700,000	\$1,117,100,000	\$346,300,000	\$2,487,100,000	—	\$2,487,100,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$62,600,000	\$100,000,000	\$26,600,000	\$189,200,000	\$61,000,000	\$250,200,000
Maintenance-of-Way	\$59,500,000	\$98,000,000	\$26,700,000	\$184,200,000	\$110,100,000	\$294,300,000
Maintenance-of-Way - New	\$19,700,000	\$31,400,000	\$8,400,000	\$59,500,000	\$20,200,000	\$79,700,000
* Police - Road, Yard, & Station	\$7,600,000	\$20,400,000	\$6,100,000	\$34,100,000	\$3,600,000	\$37,700,000
Power Directors	\$5,000,000	\$8,000,000	\$2,100,000	\$15,100,000	\$4,900,000	\$20,000,000
* Train Dispatching	\$2,600,000	\$5,200,000	\$1,600,000	\$9,400,000	\$21,100,000	\$30,500,000
* Station Maintenance & Services	\$43,000,000	\$155,700,000	\$48,300,000	\$247,000,000	—	\$247,000,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$515,900,000	\$515,900,000
* Maintenance of Equipment	\$72,500,000	\$116,800,000	\$100,700,000	\$290,000,000	—	\$290,000,000
* Onboard Services	\$50,600,000	—	—	\$50,600,000	—	\$50,600,000
* Trainmen & Enginemen	\$45,800,000	\$154,100,000	\$47,000,000	\$246,900,000	—	\$246,900,000
* Yard	\$14,500,000	\$21,400,000	\$14,500,000	\$50,400,000	—	\$50,400,000
* Fuel	\$800,000	\$1,300,000	\$1,600,000	\$3,700,000	—	\$3,700,000
* Other Transportation Ops	\$20,200,000	\$32,200,000	\$11,700,000	\$64,100,000	—	\$64,100,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$63,100,000	\$107,100,000	\$21,200,000	\$191,400,000	—	\$191,400,000
* Police, Security, Environmental	\$8,600,000	\$31,100,000	\$5,300,000	\$45,000,000	—	\$45,000,000
G&A Costs						
* G&A	\$51,200,000	\$78,900,000	\$29,000,000	\$159,100,000	—	\$159,100,000
TOTAL O&M COSTS	\$527,300,000	\$961,600,000	\$350,800,000	\$1,839,700,000	\$736,800,000	\$2,576,500,000
<i>* = Indicates above-the-rail (ATR) cost area</i>						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$496,400,000	\$155,500,000	\$(4,500,000)	\$647,400,000		

Source: NEC FUTURE team, 2015

Table 13: Alternative 3.1 (via Central CT/Providence Route Option) O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$1,250,300,000	\$1,184,000,000	\$298,400,000	\$2,732,700,000	—	\$2,732,700,000
Food & Beverage Revenue <i>(Assumed 4% of ticket revenue)</i>	\$50,000,000	—	—	\$50,000,000	—	\$50,000,000
TOTAL REVENUE	\$1,300,300,000	\$1,184,000,000	\$298,400,000	\$2,782,700,000	—	\$2,782,700,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$106,500,000	\$129,600,000	\$25,900,000	\$262,000,000	\$76,900,000	\$338,900,000
Maintenance-of-Way	\$63,300,000	\$80,600,000	\$16,800,000	\$160,700,000	\$95,100,000	\$255,800,000
Maintenance-of-Way - New	\$66,800,000	\$81,200,000	\$16,200,000	\$164,200,000	\$50,300,000	\$214,500,000
* Police - Road, Yard, & Station	\$12,300,000	\$24,600,000	\$5,700,000	\$42,600,000	\$5,500,000	\$48,100,000
Power Directors	\$8,500,000	\$10,300,000	\$2,100,000	\$20,900,000	\$6,100,000	\$27,000,000
* Train Dispatching	\$3,300,000	\$5,400,000	\$1,400,000	\$10,100,000	\$20,400,000	\$30,500,000
* Station Maintenance & Services	\$52,800,000	\$165,000,000	\$41,600,000	\$259,400,000	—	\$259,400,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$580,500,000	\$580,500,000
* Maintenance of Equipment	\$122,900,000	\$151,000,000	\$100,700,000	\$374,600,000	—	\$374,600,000
* Onboard Services	\$73,000,000	—	—	\$73,000,000	—	\$73,000,000
* Trainmen & Enginemen	\$71,700,000	\$236,700,000	\$74,000,000	\$382,400,000	—	\$382,400,000
* Yard	\$11,500,000	\$26,000,000	\$14,500,000	\$52,000,000	—	\$52,000,000
* Fuel	\$1,400,000	\$1,700,000	\$1,500,000	\$4,600,000	—	\$4,600,000
* Other Transportation Ops	\$34,300,000	\$41,800,000	\$11,400,000	\$87,500,000	—	\$87,500,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$79,500,000	\$113,500,000	\$18,300,000	\$211,300,000	—	\$211,300,000
* Police, Security, Environmental	\$10,500,000	\$33,000,000	\$4,600,000	\$48,100,000	—	\$48,100,000
G&A Costs						
* G&A	\$62,200,000	\$78,800,000	\$24,000,000	\$165,000,000	—	\$165,000,000
TOTAL O&M COSTS	\$780,500,000	\$1,179,200,000	\$358,700,000	\$2,318,400,000	\$834,800,000	\$3,153,200,000
<i>* = Indicates above-the-rail (ATR) cost area</i>						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$519,800,000	\$4,800,000	\$(60,300,000)	\$464,300,000		

Source: NEC FUTURE team, 2015

Table 14: Alternative 3.2 (via Long Island/Providence Route Option) O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$1,216,900,000	\$1,161,700,000	\$292,800,000	\$2,671,400,000	—	\$2,671,400,000
Food & Beverage Revenue <i>(Assumed 4% of ticket revenue)</i>	\$48,700,000	—	—	\$48,700,000	—	\$48,700,000
TOTAL REVENUE	\$1,265,600,000	\$1,161,700,000	\$292,800,000	\$2,720,100,000	—	\$2,720,100,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$112,300,000	\$138,100,000	\$26,700,000	\$277,100,000	\$76,900,000	\$354,000,000
Maintenance-of-Way	\$63,800,000	\$82,000,000	\$16,700,000	\$162,500,000	\$93,400,000	\$255,900,000
Maintenance-of-Way - New	\$47,200,000	\$58,100,000	\$11,200,000	\$116,500,000	\$33,800,000	\$150,300,000
* Police - Road, Yard, & Station	\$10,900,000	\$23,000,000	\$5,400,000	\$39,300,000	\$4,200,000	\$43,500,000
Power Directors	\$9,000,000	\$11,000,000	\$2,100,000	\$22,100,000	\$6,100,000	\$28,200,000
* Train Dispatching	\$3,300,000	\$5,400,000	\$1,400,000	\$10,100,000	\$20,400,000	\$30,500,000
* Station Maintenance & Services	\$52,200,000	\$164,300,000	\$41,400,000	\$257,900,000	—	\$257,900,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$603,800,000	\$603,800,000
* Maintenance of Equipment	\$129,400,000	\$160,500,000	\$100,700,000	\$390,600,000	—	\$390,600,000
* Onboard Services	\$66,600,000	—	—	\$66,600,000	—	\$66,600,000
* Trainmen & Enginemen	\$62,900,000	\$196,200,000	\$60,200,000	\$319,300,000	—	\$319,300,000
* Yard	\$11,500,000	\$26,000,000	\$14,500,000	\$52,000,000	—	\$52,000,000
* Fuel	\$1,500,000	\$1,800,000	\$1,600,000	\$4,900,000	—	\$4,900,000
* Other Transportation Ops	\$36,200,000	\$44,500,000	\$11,800,000	\$92,500,000	—	\$92,500,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$77,700,000	\$112,100,000	\$18,100,000	\$207,900,000	—	\$207,900,000
* Police, Security, Environmental	\$10,400,000	\$32,800,000	\$4,600,000	\$47,800,000	—	\$47,800,000
G&A Costs						
* G&A	\$61,800,000	\$78,300,000	\$23,600,000	\$163,700,000	—	\$163,700,000
TOTAL O&M COSTS	\$756,700,000	\$1,134,100,000	\$340,000,000	\$2,230,800,000	\$838,600,000	\$3,069,400,000
<i>* = Indicates above-the-rail (ATR) cost area</i>						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$508,900,000	\$27,600,000	\$(47,200,000)	\$489,300,000		

Source: NEC FUTURE team, 2015

Table 15: Alternative 3.3 (via Long Island/Worcester Route Option) O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$1,172,700,000	\$1,235,800,000	\$306,500,000	\$2,715,000,000	—	\$2,715,000,000
Food & Beverage Revenue (Assumed 4% of ticket revenue)	\$46,900,000	—	—	\$46,900,000	—	\$46,900,000
TOTAL REVENUE	\$1,219,600,000	\$1,235,800,000	\$306,500,000	\$2,761,900,000	—	\$2,761,900,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$110,800,000	\$136,000,000	\$26,700,000	\$273,500,000	\$80,700,000	\$354,200,000
Maintenance-of-Way	\$62,900,000	\$81,100,000	\$16,700,000	\$160,700,000	\$95,100,000	\$255,800,000
Maintenance-of-Way - New	\$45,400,000	\$55,800,000	\$11,000,000	\$112,200,000	\$34,500,000	\$146,700,000
* Police - Road, Yard, & Station	\$10,600,000	\$23,500,000	\$5,500,000	\$39,600,000	\$4,400,000	\$44,000,000
Power Directors	\$8,800,000	\$10,800,000	\$2,100,000	\$21,700,000	\$6,400,000	\$28,100,000
* Train Dispatching	\$3,300,000	\$5,500,000	\$1,400,000	\$10,200,000	\$20,400,000	\$30,600,000
* Station Maintenance & Services	\$50,300,000	\$171,900,000	\$42,600,000	\$264,800,000	—	\$264,800,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$608,000,000	\$608,000,000
* Maintenance of Equipment	\$127,700,000	\$158,300,000	\$100,700,000	\$386,700,000	—	\$386,700,000
* Onboard Services	\$67,400,000	—	—	\$67,400,000	—	\$67,400,000
* Trainmen & Enginemen	\$65,600,000	\$193,600,000	\$60,200,000	\$319,400,000	—	\$319,400,000
* Yard	\$11,500,000	\$26,000,000	\$14,500,000	\$52,000,000	—	\$52,000,000
* Fuel	\$1,400,000	\$1,800,000	\$1,600,000	\$4,800,000	—	\$4,800,000
* Other Transportation Ops	\$35,700,000	\$43,800,000	\$11,800,000	\$91,300,000	—	\$91,300,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$74,800,000	\$118,300,000	\$18,800,000	\$211,900,000	—	\$211,900,000
* Police, Security, Environmental	\$10,100,000	\$34,400,000	\$4,700,000	\$49,200,000	—	\$49,200,000
G&A Costs						
* G&A	\$60,400,000	\$80,300,000	\$24,100,000	\$164,800,000	—	\$164,800,000
TOTAL O&M COSTS	\$746,700,000	\$1,141,100,000	\$342,400,000	\$2,230,200,000	\$849,500,000	\$3,079,700,000
* = Indicates above-the-rail (ATR) cost area						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$472,900,000	\$94,700,000	\$(35,900,000)	\$531,700,000		

Source: NEC FUTURE team, 2015

Table 16: Alternative 3.4 (via Central CT/Worcester Route Option) O&M Cost Summary and Contribution Analysis

Revenue	INTERCITY SERVICES				REGIONAL SVCS	Total NEC
	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	
Ticket Revenue	\$1,105,100,000	\$1,198,500,000	\$304,500,000	\$2,608,100,000	—	\$2,608,100,000
Food & Beverage Revenue <i>(Assumed 4% of ticket revenue)</i>	\$44,200,000	—	—	\$44,200,000	—	\$44,200,000
TOTAL REVENUE	\$1,149,300,000	\$1,198,500,000	\$304,500,000	\$2,652,300,000	—	\$2,652,300,000
O&M Costs	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
Shared Infrastructure Costs						
* Electric Propulsion	\$108,200,000	\$130,900,000	\$26,700,000	\$265,800,000	\$80,700,000	\$346,500,000
Maintenance-of-Way	\$62,900,000	\$79,700,000	\$17,000,000	\$159,600,000	\$96,200,000	\$255,800,000
Maintenance-of-Way - New	\$43,400,000	\$52,500,000	\$10,700,000	\$106,600,000	\$33,700,000	\$140,300,000
* Police - Road, Yard, & Station	\$10,100,000	\$22,800,000	\$5,400,000	\$38,300,000	\$4,400,000	\$42,700,000
Power Directors	\$8,600,000	\$10,400,000	\$2,100,000	\$21,100,000	\$6,400,000	\$27,500,000
* Train Dispatching	\$3,300,000	\$5,400,000	\$1,400,000	\$10,100,000	\$20,400,000	\$30,500,000
* Station Maintenance & Services	\$47,300,000	\$167,200,000	\$42,500,000	\$257,000,000	—	\$257,000,000
Transportation Operations Costs						
* Regional Transportation Ops	—	—	—	—	\$584,700,000	\$584,700,000
* Maintenance of Equipment	\$124,800,000	\$152,400,000	\$100,700,000	\$377,900,000	—	\$377,900,000
* Onboard Services	\$66,200,000	—	—	\$66,200,000	—	\$66,200,000
* Trainmen & Enginemen	\$66,000,000	\$196,000,000	\$60,200,000	\$322,200,000	—	\$322,200,000
* Yard	\$11,500,000	\$26,000,000	\$14,500,000	\$52,000,000	—	\$52,000,000
* Fuel	\$1,400,000	\$1,700,000	\$1,600,000	\$4,700,000	—	\$4,700,000
* Other Transportation Ops	\$34,900,000	\$42,200,000	\$11,800,000	\$88,900,000	—	\$88,900,000
Sales & Marketing, National Ops Costs						
* Sales & Marketing	\$70,500,000	\$114,900,000	\$18,700,000	\$204,100,000	—	\$204,100,000
* Police, Security, Environmental	\$9,500,000	\$33,400,000	\$4,700,000	\$47,600,000	—	\$47,600,000
G&A Costs						
* G&A	\$58,700,000	\$79,300,000	\$24,400,000	\$162,400,000	—	\$162,400,000
TOTAL O&M COSTS	\$727,300,000	\$1,114,800,000	\$342,400,000	\$2,184,500,000	\$826,500,000	\$3,011,000,000
<i>* = Indicates above-the-rail (ATR) cost area</i>						
Net Contribution Cost Definition	Intercity-Express	Metropolitan	Intercity-Corridor	Total Intercity	Commuter RRs	Total NEC
NET CONTRIBUTION	\$422,000,000	\$83,700,000	\$(37,900,000)	\$467,800,000		

Source: NEC FUTURE team, 2015

Table 17: No Action and Action Alternatives Summary

Alternative	Service*	Revenue	O&M Cost	Net Contribution
No Action	EXP	\$964,100,000	\$358,300,000	\$605,800,000
	MET/ IC	\$935,400,000	\$548,300,000	\$387,100,000
	TOTAL	\$1,899,500,000	\$906,600,000	\$992,900,000
Alternative 1	EXP	\$803,900,000	\$331,000,000	\$472,900,000
	MET/ IC	\$1,369,400,000	\$995,900,000	\$373,500,000
	TOTAL	\$2,173,300,000	\$1,326,900,000	\$846,400,000
Alternative 2	EXP	\$1,023,700,000	\$527,300,000	\$496,400,000
	MET/ IC	\$1,463,400,000	\$1,312,400,000	\$151,000,000
	TOTAL	\$2,487,100,000	\$1,839,700,000	\$647,400,000
Alternative 3.1 (via Central CT/Providence route option)	EXP	\$1,300,300,000	\$780,500,000	\$519,800,000
	MET/ IC	\$1,482,400,000	\$1,537,900,000	\$(55,500,000)
	TOTAL	\$2,782,700,000	\$2,318,400,000	\$464,300,000
Alternative 3.2 (via Long Island/Providence route option)	EXP	\$1,265,600,000	\$756,700,000	\$508,900,000
	MET/ IC	\$1,454,500,000	\$1,474,100,000	\$(19,600,000)
	TOTAL	\$2,720,100,000	\$2,230,800,000	\$489,300,000
Alternative 3.3 (via Long Island/Worcester route option)	EXP	\$1,219,600,000	\$746,700,000	\$472,900,000
	MET/ IC	\$1,542,300,000	\$1,483,500,000	\$58,800,000
	TOTAL	\$2,761,900,000	\$2,230,200,000	\$531,700,000
Alternative 3.4 (via Central CT/Worcester route option)	EXP	\$1,149,300,000	\$727,300,000	\$422,000,000
	MET/ IC	\$1,503,000,000	\$1,457,200,000	\$45,800,000
	TOTAL	\$2,652,300,000	\$2,184,500,000	\$467,800,000

* EXP = Intercity-Express, MET/ IC = combined Metropolitan and Intercity-Corridor services

Source: NEC FUTURE team, 2015