Transforming Rail in Virginia

Economic and Social Impacts

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EXECUTIVE SUMMARY

This study evaluates the economic effects of the Virginia Passenger Rail Authority's (VPRA) Transforming Rail in Virginia (TRV) initiative, in particular the economic effects of capital projects identified in the VPRA FY 2025 budget amendment and passenger service improvements that will be made by FY 2035. The goal of the initiative is to expand and improve passenger rail services across Virginia through major track right-of-way acquisitions, rail infrastructure investments, and passenger service enhancements.

The report begins with an overview of the TRV and a description of the existing rail services in Virginia, including Amtrak state-supported and long-distance services, and commuter rail services provided by Virginia Railway Express (VRE). It outlines the establishment of VPRA, its mission to support and expand passenger rail services, and the funding sources for TRV. Key milestones in the development of TRV are also discussed, including significant infrastructure investments and service-level improvements planned for major corridors, such as Richmond to Washington, D.C.; Washington, D.C. to the New River Valley; and Richmond to Raleigh, North Carolina.

Next, the report describes the characteristics and trends of passenger and freight rail transportation in Virginia. It presents data on national, state, and regional rail transportation and freight trends, emphasizing the role of TRV in enhancing transportation flows. This section also examines factors affecting future passenger and freight rail transportation, such as urbanization, economic activity, demographic trends, and public transportation policies. The resurgence in Amtrak ridership post-COVID-19 and the challenges faced by VRE in recovering ridership levels are highlighted.

The study then reviews the socioeconomic effects of passenger rail improvements, drawing from regional economic theories and empirical evidence. It discusses how transportation improvements can influence economic growth and development, property values, land use, accessibility, and social wellbeing. The report also explores how TRV removes barriers to passenger rail use and examines the potential for rail improvements to stimulate agglomeration economies and provide other social benefits.

Methodologies used to estimate the economic impacts and benefits of TRV are outlined, including economic impact analysis and social cost-benefit analysis (SCBA). The report describes the IMPLAN economic impact model used to gauge TRV's economic contribution to Virginia and the Benefit-Cost Analysis (BCA) developed for VPRA to evaluate rail infrastructure projects. The IMPLAN economic impact analysis shows how TRV capital investment and increased spending for passenger rail operations affect state economic activity, including employment, labor income, value-added and output. The BCA assesses the value of proposed

projects by quantifying expected benefits and costs, including travel time savings, safety benefits, and environmental effects.

The economic impact results of TRV-related activities are presented, including both capital investment impacts and operational impacts. The study estimates that nearly $4.7 billion in statewide capital spending will support 22,100 jobs, generating $1.8 billion in labor income, $2.4 billion in value-added, and $4.1 billion in output. These are cumulative impacts over the duration of the capital investment plan, projected to occur over the period state fiscal year (FY) 2025 to FY 2035, and each job has a one-year duration. The total cumulative economic impact over the same period, including indirect and induced effects, is projected to be 33,668 jobs, $2.6 billion in labor income, $4.0 billion in value-added, and $6.7 billion in output. State-supported rail operations (termed the "TRV Operations") in FY 2035 are expected to support 1,062 jobs, $89.4 million in labor income, $186.5 million in value-added, and $361.4 million in output. TRV Operations economic impacts result from the operation of all state-supported train services and are annual and recurring. The added economic activity due to TRV passenger service enhancements through FY 2035 (termed the "TRV operations expansion") will add 198 jobs, $16.8 million in labor income, $35 million in value-added, and $68 million in output. The economic impacts of TRV operations expansion include the additional economic activity resulting from the provision of additional train services through FY 2035. These economic impacts are also annual and recurring. A regional breakdown of these cumulative and annual economic impacts highlights significant impacts for the Washington-Arlington-Alexandria, Richmond, and Blacksburg-Christiansburg metropolitan areas (see **Tables E.1-E.3**).

Table E.1 TRV Capital Investment Total Impacts by Region, Cumulative FY 2025-2034

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	896	$44,324,460	$68,747,052	$143,108,713
Charlottesville MSA	23	$1,451,462	$2,613,666	$5,389,611
Richmond MSA	1,879	$135,816,424	$214,237,785	$369,387,711
Washington-Arlington-Alexandria MSA	29,506	$2,373,381,108	$3,566,290,123	$5,910,720,692
Rest of Virginia	1,385	$80,077,598	$149,424,539	$297,489,686
TOTAL	**33,688**	**$2,635,051,052**	**$4,001,313,165**	**$6,726,096,413**

Table E.2 TRV Operations Total Economic Impact by Region in FY 2035

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	15	$1,102,561	$2,335,788	$4,831,221
Charlottesville MSA	42	$3,531,764	$7,194,363	$14,329,752
Lynchburg MSA	51	$3,836,933	$8,685,556	$17,261,795
Richmond MSA	323	$28,595,066	$56,865,946	$105,776,947
Roanoke MSA	31	$2,314,103	$4,947,447	$9,859,290
Virginia Beach-Newport News MSA	98	$7,564,093	$15,508,058	$30,659,816
Washington-Arlington-Alexandria MSA	362	$31,777,676	$66,589,128	$128,545,695
Rest of Virginia	141	$10,697,349	$24,356,236	$50,158,462
TOTAL	**1,062**	**$89,419,546**	**$186,482,522**	**$361,422,979**

Table E.3 TRV Operations Expansion Total Economic Impact by Region in FY 2035

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	14	$1,046,252	$2,234,481	$4,631,195
Charlottesville MSA	1	$95,117	$179,602	$359,952
Lynchburg MSA	1	$89,642	$243,587	$437,324
Richmond MSA	57	$5,040,424	$10,040,082	$18,708,993
Roanoke MSA	2	$123,303	$285,380	$545,921
Virginia Beach-Newport News MSA	12	$923,147	$1,874,546	$3,699,086
Washington-Arlington-Alexandria MSA	81	$7,096,680	$14,923,121	$28,851,974
Rest of Virginia	30	$2,337,363	$5,321,840	$10,986,317
TOTAL	**198**	**$16,751,927**	**$35,102,640**	**$68,220,762**

The additional economic activity created by TRV will also generate additional federal, state, and local government (mainly tax) revenues. The capital investment activities of TRV will generate an additional $104 million in local, $139 million in state, and $588 million in federal government revenue. The operations of state-supported routes will generate $2.2 million in local, $5 million in state, and nearly $23 million in federal government revenues. Operations expansion, which represent approximately 20% of total operations in FY 2035, will generate $393 thousand local, $918 thousand state, and $4.3 million in federal government revenues.

Finally, the report examines other economic and social impacts of TRV, including social benefits and potential secondary economic impacts. It assesses the broader effects of traffic diversion from automobile to passenger rail, such as reduced road congestion, lower vehicle emissions, and improved safety. The potential for TRV to enhance quality of life and equity by expanding access to employment centers, educational institutions, and recreational areas is also considered. The analysis suggests that TRV will generate substantial social benefits, including travel time savings, vehicle operating cost savings, and crash reduction benefits. When vehicular operations savings, driving time savings, and safety improvements are translated into inputs and used in economic impact analysis, the results are not negligible. Findings suggest that the total economic impacts (an estimated 63 jobs) represent about one-third of the 198 total employment impact of TRV operations expansion.

In conclusion, the TRV initiative will stimulate Virginia's economy through substantial capital investments and operational enhancements made through FY 2035. The initiative will not only create jobs and increase economic output but also generate substantial federal, state, and local government tax revenue and provide extensive social and environmental benefits to the Commonwealth's citizens. The improvements in passenger rail services will enhance connectivity, expand transportation options, reduce road congestion, and promote sustainable development across the Commonwealth. These positive impacts and benefits will increase as the TRV initiative moves into future phases.

INTRODUCTION

The purpose of this study is to assess the economic effects of the Virginia Passenger Rail Authority's (VPRA) Transforming Rail in Virginia (TRV) initiative on the Commonwealth of Virginia and selected regions. VPRA was established in 2020 by the Virginia General Assembly (Section 33.2-287 et seq. of Chapter 1230 of the 2020 Acts of Assembly) to support, promote, and expand passenger rail services in Virginia. Transforming Rail in Virginia is a program led by VPRA to expand and improve passenger rail in the Commonwealth. The program involves major track right-of-way acquisitions, rail infrastructure investments, and passenger service additions and improvements. The analysis estimates the program's effects on Virginia's economy in the next decade through capital investment and expanded passenger rail transportation operations, including its effect on economic output, income, employment, and tax revenue. The study also explores other potential wide-ranging effects of TRV, including its impact on rail transportation usage and its broader economic and social implications.

This study builds upon previous analyses conducted by the Stephen Fuller Institute, Virginia Commonwealth University, and the Southeast Corridor Commission, which examined the economic impacts of TRV on the state economy. The former two reports had a targeted geographical focus on the economic effects for the Washington, D.C. metropolitan region of the planned Long Bridge improvements (Chapman and Fuller 2019) and the effects of Richmond area corridor improvements within the Richmond region (MacKenzie 2022). The latter report examined the economic impacts of the full build out impact of Southeast Rail System through the year 2055 (Southeast Corridor Commission 2021). This study, in comparison, looks at the economic impacts of capital projects identified in the VPRA FY 2025 budget (VPRA 2024) and passenger service improvements services that will be made by FY 2035. The capital projects included in this report are from Phases 1 and 2 of I-95 corridor improvements and restoration of rail service to the New River Valley that are expected to occur over the State Fiscal Year (FY) 2025- FY 2035 period. Not included in the report are many capital improvements associated with Phase 3 and 4 for the I-95 corridor, the Richmond to Raleigh corridor, and Hampton Roads connection that are in the conceptual and planning stages and likely to occur later.

The study is divided into six sections.

The study begins with an in-depth examination of the existing rail passenger landscape in Virginia and role of the Transforming Rail in Virginia initiative. Included in this section is an overview of the VPRA—its creation and responsibilities, and of the TRV—its rationale, historical context, and key milestones. It also describes each major corridor within TRV, and

the status of planning, development, engineering, construction, and operation improvements.

The second section describes passenger and freight rail transportation in Virginia. It presents information on national, Virginia, and regional rail transportation and freight characteristics, highlighting TRV's contribution to transportation flows. It also examines factors affecting passenger and freight rail transportation, including current and future national and regional economic and demographic trends.

The third section provides a literature review that examines the effects of passenger rail improvements on regional economic growth and social wellbeing. Drawing upon regional economic theories and empirical evidence, the review describes the scholarly ex-post research studies regarding the effects of these transportation improvements on regional growth, development, property prices, productivity, and land uses, as well as their effects on the environment and public health.

The fourth section describes the methodologies used to estimate the economic impacts and benefits of TRV. It also describes different ways of quantifying (ex-ante) the economic impacts and social benefits and costs of transportation improvements. These include economic impact analysis and social cost-benefit analysis. It then describes the methodological properties of the IMPLAN economic impact model, inputs used, and specific elements examined in the social cost-benefit analysis, including travel time savings, safety benefits, and environmental benefits.

The fifth section presents estimates of the statewide comprehensive economic impacts and social benefits of Transforming Rail in Virginia. Economic outcome variables examined include employment, output, value-added, labor income, and government tax revenue. It further provides a description of regions affected by TRV improvements and breakdown of capital investment and operational impacts for regions within Virginia. These regions include Blacksburg-Christiansburg Metropolitan Statistical Area (MSA); Charlottesville MSA; Lynchburg MSA; Richmond MSA; Roanoke MSA; Washington-Arlington-Alexandria MSA; Virginia Beach-Newport News MSA; and a region consisting of the remaining areas in Virginia.

The sixth section describes qualitative and quantitative benefits and other economic impacts not included in the economic impact analysis of TRV. These broader effects include social benefits and economic impacts stemming from the shift of traffic from automobile to passenger rail. The first subsection examines the resulting social benefits. These are assessed using TRV traffic projections for Amtrak state-supported routes using the TRV Phase 2 BCA model, examining various levels for travel time savings, safety benefits, and environmental

effects. In addition, the section examines wider economic benefits and other considerations not ordinarily examined in social cost-benefit analysis. The second subsection examines potential secondary or dynamic economic impacts stemming from passenger rail improvements, including single-occupancy vehicular operating cost savings from switching to more economical passenger train travel, business and personal productivity improvements resulting from combining work, and travel and consumer/employer savings resulting from safety improvements.

SECTION 1

TRANSFORMING RAIL IN VIRGINIA

This section provides an overview of the rail transportation landscape in Virginia with a focus on the catalyzing role of the Transforming Rail in Virginia initiative. In the first subsection, existing rail service in Virginia is described, including passenger rail, such as Amtrak state-supported and long-distance services, commuter rail services provided by Virginia Railway Express (VRE), light rail services, metro/subway, and freight rail service. The next subsection examines VPRA, including its history, statutory authority, mission, and objectives. The following subsection outlines TRV's objectives, rationale, historical context, and key milestones and describes how TRV enhances state rail service and promotes other state goals. The final subsection summarizes each major corridor within the TRV initiative. It also examines the process and criteria for determining upgrades to rail corridor, infrastructure, and service.

Passenger Rail Service in the Commonwealth

Passenger rail services in Virginia provide different transportation needs, from local commuting to long-distance travel. Amtrak provides non-commuter passenger rail services, operating up to 30 trains and 11 routes per day in Virginia while serving 21 passenger rail stations (VDRPT 2023). They consist of three different types:

1. Regional intercity service provided through Amtrak's Northeast Regional service and supported by Virginia, which provides trains several times daily for intercity travel within the state and to other nearby states. It consists of four routes: Washington, D.C. to Richmond (one daily roundtrip); Washington, D.C. to Norfolk (three daily roundtrips); Washington, D.C. to Newport News (two daily roundtrips); and Washington, D.C. to Roanoke (two daily roundtrips)
2. Long-distance intercity service consisting of six routes: the Cardinal (tri-weekly from New York City to Chicago), the Crescent (daily from New York City to New Orleans), the Palmetto (daily from New York City to Savannah), the Silver Meteor (daily from New York City to Miami), the Silver Star (daily from New York City to Miami), and the Auto Train (daily from Lorton, Virginia to Sanford, Florida)
3. An interstate corridor service, the Carolinian (daily from New York City to Charlotte), operated by Amtrak and supported by North Carolina, that passes through Virginia (VDRPT 2023).

For the four state-supported corridors operating in Virginia as extensions of Amtrak's Northeast Regional service, the Commonwealth is responsible for covering the costs of day-to-day operations and maintenance as well as capital costs for equipment. The annual budgets for Virginia's state-supported services include annual revenues, farebox recovery, and payments to Amtrak made by Virginia for services (VDRPT 2023).

The Commonwealth also provides local commuter rail services through the Virginia Railway Express (VRE), which provides commuter service for the Washington, D.C. area and urban and suburban communities in Northern Virginia. VRE operates two routes: Washington, D.C. to Broad Run (the Manassas Line) and Washington, D.C. to Spotsylvania (the Fredericksburg Line). Each line operates eight weekday roundtrips, primarily during peak hours for a total of 32 weekday trains on two lines. VRE is owned and operated by the Northern Virginia Transportation Commission (NVTC) and the Potomac and Rappahannock Transportation Commission (PRTC), which are Commonwealth of Virginia political subdivisions (VRE 2023). Commuter trains are operated under contract by Keolis Rail Services America, using Keolis train crews and VRE-owned equipment. The Washington Metropolitan Area Transit Authority's (WMATA) Metrorail systems' Blue Line and Yellow Line extend into Northern Virginia, serving key areas such as Arlington, Alexandria, and Fairfax County. Hampton Roads Transit in Norfolk operates a 7.4-mile line light rail system, called The Tide, that connects various points in Norfolk. Lastly, the Virginia Scenic Railway in Staunton offers scenic excursions in the Shenandoah Valley but does not have connectivity to rail main lines. Connections between passenger and commuter and rail transit systems are provided at various points. State-supported Amtrak routes are also accessible to more Virginia communities though Amtrak Thruway and state-supported Virginia Breeze intercity bus service.

Virginia Passenger Rail Authority

The Virginia Passenger Rail Authority (VPRA) is a political subdivision responsible for overseeing and expanding passenger rail services in Virginia. It was established in 2020 by the Virginia General Assembly (Section 33.2-287 et seq. of Chapter 1230 of the 2020 Acts of Assembly). Its mission is to support, promote, and expand passenger rail services in Virginia. This includes improving the reliability, frequency, and accessibility of passenger and commuter rail service throughout the Commonwealth, promoting economic growth, providing varied transportation options, and reducing traffic congestion and environmental impacts. VPRA is also tasked with implementing long-term strategies to enhance the state's rail infrastructure, ensuring that it meets the needs of Virginia's growing population.

The Commonwealth Rail Fund (CRF) was created as part of the same transportation legislative initiative that created VPRA. This fund takes 7.5% of Commonwealth Transportation Trust Funds, 93% of which are dedicated to VPRA and distributed to the Authority, while the remaining 7% are allocated to the Virginia Department of Rail and Public Transportation (VDRPT). Before VPRA, passenger rail initiatives in Virginia were managed by the VDRPT. The VDRPT laid the groundwork for many of the state's passenger rail improvements, but establishing VPRA allowed for more focused and dedicated efforts. VPRA was also assigned additional authorities and responsibilities beyond VDRPT's prior roles, including management of design and construction, right-of-way acquisition and abandonment, third-party coordination, and operations oversight (VDRPT 2023).

The responsibilities of the VPRA include the following:

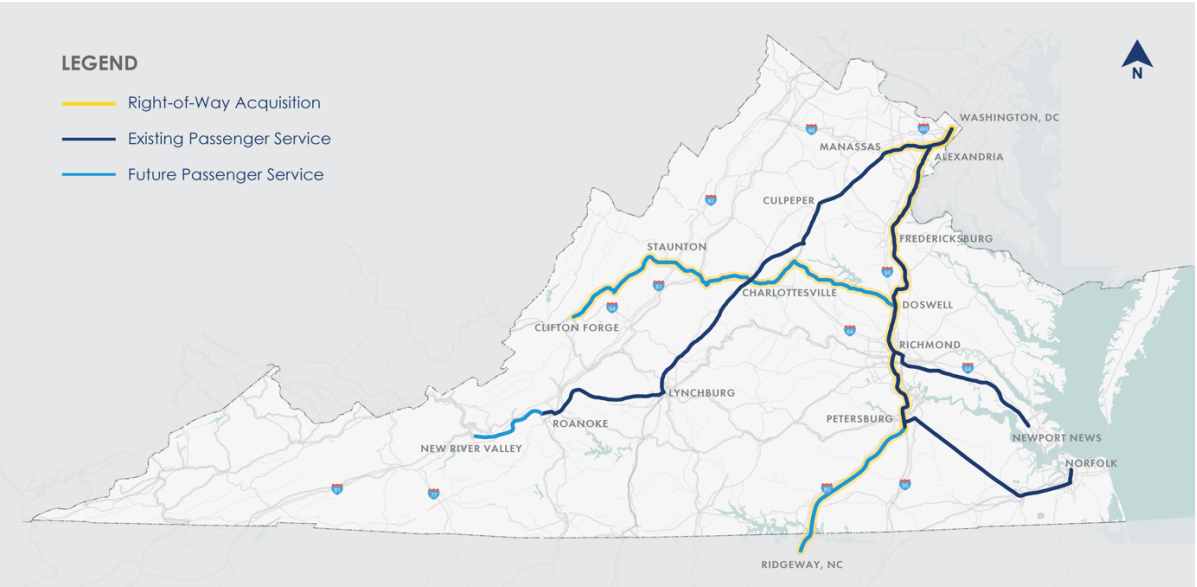
- **Rail Service Planning and Management:** VPRA oversees the planning, development, maintenance, and expansion of passenger rail services, including Amtrak routes within Virginia. This involves managing agreements with freight rail companies to ensure that passenger services operate efficiently on shared tracks. It also manages the state-supported Amtrak Virginia passenger rail service, which currently consists of eight daily roundtrips originating in Richmond, Norfolk, Newport News, and Roanoke. VPRA also works in partnership with the VRE to improve commuter rail service in Virginia.
- **Infrastructure Development:** VPRA is responsible for planning and executing rail infrastructure projects (e.g. Transforming Rail in Virginia), which include capital investments, such as track improvements, station upgrades, and the construction of new rail lines.
- **Funding and Partnerships:** VPRA administers a portfolio of Capital and Operating Grants and other funds. As part of the enabling legislation, VPRA can accept grants, donations, and loans; borrow money; and issue bonds to finance and refinance rail facilities. VPRA manages state and federal funding for rail projects and works with local governments, the private sector, and other stakeholders to secure additional resources.

Transforming Rail in Virginia Overview

Transforming Rail in Virginia is a program initiated by the Commonwealth of Virginia to significantly expand and improve passenger rail in the state. The initiative is led by the Virginia Passenger Rail Authority. The program involves major track right-of-way acquisitions, rail infrastructure investments and passenger service additions and improvements (VDRPT 2023). It also involves the addition of new rail services, such as expanded Amtrak routes to connect regions in Virginia like the New River Valley.

The Transforming Rail in Virginia initiative is expected to transform the state's transportation landscape by providing more frequent, reliable, economically efficient, and sustainable rail services (see **Figure 1.1**). There are three fundamental driving factors behind TRV. First, due to the growth of the state's population and economy, increasing transportation demand has created pressure on the state's existing infrastructure, which has led to concerns about traffic congestion, limited rail capacity, and the environment. Traffic growth, particularly along the I-95 corridor, has led to delays, increased emissions, and economic inefficiency, which has led to a search for targeted solutions to remedy these problems (VDOT 2021). Second, the state's rail infrastructure was primarily designed for freight, with limited ability to accommodate passenger services, which has constrained the ability to expand passenger rail services, resulting in service and reliability issues. Third, growing environmental awareness and the need to reduce greenhouse gas emissions to combat climate change has increased attention to more sustainable transportation options, such as passenger rail, which is more energy-efficient and environmentally friendly than car or air travel.

Figure 1.1 Transforming Rail in Virginia Routes

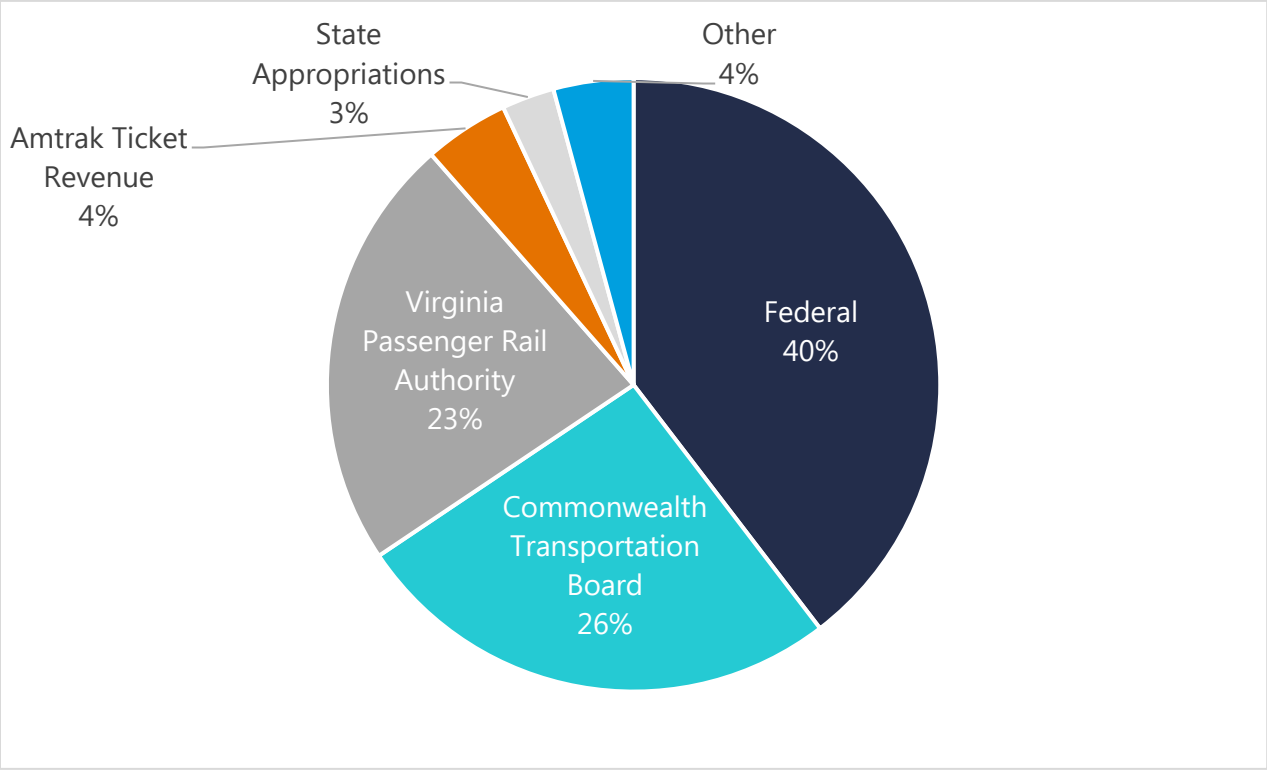


Source: Virginia Passenger Rail Authority

The Transforming Rail in Virginia initiative receives funding from a variety of federal government, state government, and other sources. A major source of funding is the Commonwealth Rail Fund, which was established in 2020. This fund provides a dedicated source of revenue for rail investments, supported by state transportation revenues, including fuel taxes. In addition, the Virginia General Assembly has allocated substantial funds for rail projects through its budgetary process. The initiative has also received substantial funding through federal government programs.

Approximately 40% of the funding for the TRV capital investments covered in this report comes directly from federal government sources (see **Figure 1.2**), including Federal Railroad Administration Grants and Amtrak capital contributions. However, the ultimate federal contribution is likely much higher since many state and local sources of funding for the TRV projects rely partly on pass-through funds from the federal government. Approximately half of the funding comes from the Commonwealth Transportation Board (26%) and VPRA (23%). The remaining 11% is derived from a variety of sources including Amtrak ticket revenue, state appropriations, local funds, and the North Carolina Department of Transportation (which represent pass-through funds from the federal government).

Figure 1.2 Sources of Funding for TRV Capital Investments



Source: Virginia Passenger Rail Authority

Table 1.1 describes key milestones in the development of the TRV initiative. Many of the early formative milestones were achieved before VPRA was created in 2020. For example, the Southeast High Speed Rail Tier I Environmental Impact Statement (EIS), which analyzed the overall feasibility and planning for the project and forms the backbone of TRV I-95 improvements, was completed in 2002. Phase II EIS documents for the D.C. to Richmond and Richmond to Raleigh corridor segments, provided design elements and detailed site-specific analysis impacts associated with the broader project and were completed in 2015 (R2R) and 2019 (DC2RVA) respectively. In 2021, VRPA announced a Right-of-Way agreement with CSX to acquire key corridor segments to allow the separation of passenger and freight operations. Another important announcement in 2023 was securing significant funding for an expansion of Long Bridge, which crosses the Potomac River and is a key component to expanding passenger and freight rail volumes, speeds, and on-time performance. Additionally, in 2024 VPRA announced an agreement with Norfolk Southern to purchase the Manassas Line which also provided access to Norfolk Southern's Main Line for a more efficient extension of service to the New River Valley.

Table 1.1 Transforming Rail in Virginia Milestones

Milestone	Description	Year
Southeast High-Speed Rail Tier I EIS Completion	Southeast High-Speed Rail Tier I Environmental Impact Statement (EIS) for DC to Charlotte, NC, which includes DC2RVA and R2R corridors.	2002
Lynchburg Service Initiated	Virginia state-supported daily round-trip service launches between Lynchburg and Washington, D.C.	2009
Richmond Service Initiated	Virginia state-supported daily round-trip service started between Richmond and Northeast Corridor.	2010
Richmond/Hampton Roads Passenger Rail Project EIS Phase I Completion	Richmond/Hampton Roads Passenger Rail Project EIS Phase I.	2012

Milestone	Description	Year
Norfolk Service Extension	Extension of state-supported daily round-trip service from Richmond eastward was made to initiate service between Norfolk and Northeast Corridor.	2012
NRV Passenger Rail Initiative	NRV passenger rail community initiative is formed to bring passenger rail service back to the NRV.	2013
R2R Phase II EIS Completion	Southeast High-Speed Rail: Tier II Final Environmental Impact Statement and Final Section 4(f) Evaluation completed for Richmond, VA, to Raleigh, NC.	2015
Federal Funding for Alexandria Fourth Track	Commonwealth was awarded $45 million in federal funding for the Alexandria Fourth Track Project.	2016
Roanoke Service Extension	State supported daily round-trip passenger rail service is extended to Roanoke.	2017
DC to Richmond Southeast High-Speed Rail Phase II EIS Completion	Southeast High-Speed Rail: Tier II Final Environmental Impact Statement and Final Section 4(f) Evaluation completed for Washington, D.C. to Richmond, VA.	2019
Second Norfolk Service Initiated	Second state-supported Norfolk daily round-trip service created by extending second Richmond train to Norfolk.	2019
VPRA Established	VPRA was established to oversee and implement passenger rail initiatives, including the Transforming Rail in Virginia initiative.	2020
CSX Agreement	Virginia finalized an agreement with CSX to acquire 225 miles of rail right-of-way and 350 miles of track. This acquisition included key segments of the Washington, D.C. to Richmond Corridor.	2021
Norfolk Southern Agreement	Agreement with Norfolk Southern Railway to extend passenger rail service form Roanoke to the NRV is announced.	2021

Milestone	Description	Year
Richmond Service Extension	State-supported Richmond train extended from Richmond Staples Mill Station to Main Street station in Richmond, VA.	2021
NRV Passenger Rail Station Feasibility Study	Study to identify and select feasible passenger rail station location completed.	2022
Third Norfolk Service Initiated	Third state-supported daily round-trip between Norfolk and Northeast Corridor began.	2022
Second Roanoke Service Initiated	Second daily round-trip between Roanoke service and Northeast Corridor began.	2022
New River Valley Passenger Rail Project	Agreement finalized that includes a second train on the Roanoke route, an extension of trains to the NRV, and purchase of 28 miles of track from Salem to Christiansburg on the V-Line.	2022
Federal Funding for Ettrick Station Improvements	VRPA is awarded $6.4 million federal grant to make upgrades to Petersburg Ettrick train station.	2022
Federal Funding for Long Bridge Pedestrian Crossing	VRPA is awarded $20 million federal grant for Long Bridge bicycle and pedestrian bridge.	2022
Major Federal Funding for Phases 1 and 2	Announcement of federal funding package for Phase 2 TRV improvements, including Long Bridge expansion and rail improvements in Prince William, Stafford, and Spotsylvania counties ($729 million) and Franconia-Springfield Bypass ($100 million).	2023
Richmond Layover Facility Feasibility Study	Study completed to identify potential sites for a new Richmond area layover facility.	2023
Norfolk Southern Agreement	Agreement with Norfolk Southern to purchase the Manassas Line and gain access to the Norfolk Southern Main Line for service to the New River Valley.	2024

Transforming Rail in Virginia Capital and Service Improvements

The Transforming Rail in Virginia initiative encompasses several key rail corridors across the state, each selected for its importance in improving passenger rail service, reducing congestion, and supporting economic growth.[i] Each corridor's infrastructure upgrades are designed to address specific challenges, such as capacity constraints and aging infrastructure, while service-level improvements will provide residents with more reliable, frequent, and sustainable transportation options. Below is a summary of each major corridor within the program, including the significant infrastructure investments planned and the anticipated service-level improvements.

Richmond to Washington, D.C.

This corridor, known as the Richmond, Fredericksburg & Potomac (RF&P) Corridor, connects Richmond, Virginia with Washington, D.C. It is heavily used by both passenger and freight trains, making it one of the busiest rail corridors on the East Coast.

Construction in this corridor will occur incrementally over an extended period, providing seamless third and fourth rail enhancements and full separation of freight and passenger rail services, which will enable passenger trains to increase speed and reliability. This corridor will realize many major infrastructure investments before FY 2035, totaling approximately $4.3 billion for Phases 1 and 2 as detailed in this report (see **Table A.1**). Passenger rail speeds are expected to reach up to 90 mph along some segments operated between Washington Union Station and Main Street Station in Richmond. However, the Phase 1 and 2 infrastructure improvements covered in this report will add multiple bridges, tracks, sidings, and other improvements that will go a long way towards fulfilling this goal, improving capacity, reducing delays, and allowing for more frequent passenger services. The largest single project is the Long Bridge Project, which is the construction of a new bridge dedicated solely to passenger rail across the Potomac River, with a budget of nearly $2.3 billion divided into two parts: Long Bridge-South Package and Long Bridge-North Package. This project involves construction of a new, two-track rail bridge parallel to the existing Long Bridge over the Potomac River, which will be built to increase capacity and alleviate a significant bottleneck for both passenger and freight trains. Once this significant transportation bottleneck is removed, it will permit passenger and freight services to increase from 76 trains today to 192 trains on completion (Chapman and Fuller 2019). In addition, Richmond's Main Street Station will undergo significant upgrades, including (in 2028) a new a layover facility for storing and servicing trains that will replace the existing one at Staples Mill Road.

In tandem with the infrastructure investments, service-level improvements are planned that include doubling the number of state-supported Amtrak trains between Richmond and Washington, D.C. During the first phase of the plan, two new state-supported trains starting in Washington, D.C. will serve Richmond, with one of them terminating in Newport News. During the second phase, three additional state-supported trains from Washington, D.C. to Richmond will be added by 2030.

Washington, D.C. to New River Valley

This corridor extends from Washington, D.C. through Charlottesville and Lynchburg to Roanoke with plans for future expansion to the New River Valley. The extension to the New River Valley will bring passenger rail service back to the region for the first time since 1979. Planning and design for the project is underway to determine the exact infrastructure needed to support the expanded services. The project will include improvements between Roanoke and Christiansburg including additional sidings to enhance capacity and reliability, allowing for more frequent and faster trains. A new station will be constructed in Christiansburg to serve as an entry and departure point. In addition, a layover facility for the storage of trains will be constructed in Radford. The project will also modernize signaling and communication systems to improve safety and operational efficiency. The economic impacts of these planned capital and service improvements are estimated in this report.

Washington, D.C. to Newport News/Norfolk (Hampton Roads Corridor)

These corridors connect Washington, D.C. to Virginia's Hampton Roads region, including the cities of Newport News and Norfolk. A new Transportation Center opened in Newport News on August 22, 2024 for travelers on Amtrak and the regional bus system. Beginning in 2026, a new daily roundtrip option will be added to the Newport News corridor. Although still in the planning stage, the existing route from Richmond to Newport News north of the James River will likely maintain conventional rail service with speeds of up to 79 miles per hour (FRA 2012). Future improvements outside the scope of this report would include limited track improvements and grade-crossing improvements. The more substantive improvements to the route from Richmond to Norfolk south of the James River are outside the scope of this report but will include updates, such as third track and siding, that will allow for higher-speed rail service supporting speeds of 90-110 miles per hour (FRA 2012). New rail services could be introduced in the Norfolk corridor when those improvements are completed.

Richmond to Raleigh, North Carolina (S-Line Corridor)

This corridor runs from Richmond through Southern Virginia to Raleigh, North Carolina. It is part of a broader initiative to establish higher performance passenger rail service in the Southeast and is being coordinated with the North Carolina Department of Transportation. This project includes Right-of-Way acquisition and eventually major infrastructure improvements to offer Virginia's fastest rail travel time, with speeds approaching 110 miles over the rail track segment from Collier, VA to Raleigh NC (FRA 2015). Improvements on the S-Line, a former freight rail line, will involve track upgrades, including the construction of new track and rebuilding of the existing track with sidings, straightening of curves, new signaling, station upgrades, and construction of a new station in La Crosse, Virginia (FRA 2015). As part of this report and analysis, two capital budget items that benefit the corridor are included: S-Line 30% design, a planning project to promote future capital improvements on the line VPRA acquired from CSX, and renovation of the Ettrick Station in Petersburg.

When the project is complete, Amtrak will introduce a new regional service that connects Washington, D.C. with Southern Virginia cities, such as Petersburg and La Crosse, with further connections to Raleigh, NC and points south when corresponding rail improvements are also completed on the North Carolina segments of the corridor. The corridor is anticipated to provide four daily higher speed round trips between Richmond and Raleigh (FRA 2015).

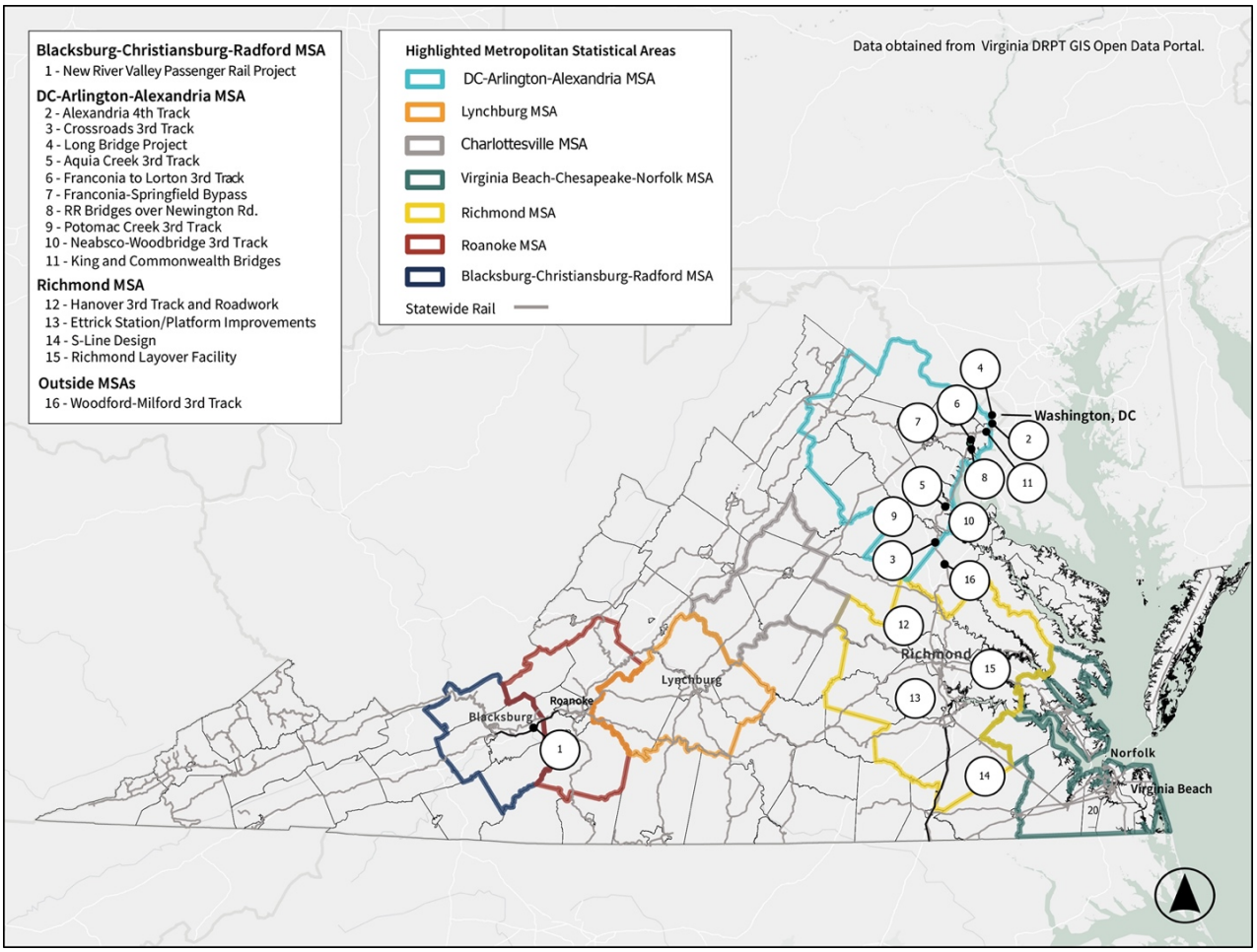
TRV Capital Improvement Projects and Service Expansions Covered in Report

This report assesses the economic effects of capital projects identified in the VPRA FY 2025 budget. The TRV projects are anticipated to be completed before FY 2035. These projects are not all of the investments that VRPA will make in TRV. They consist mainly of Phase 1 and 2 projects along the I-95 corridor that are needed to return passenger rail service to the New River Valley and selected other projects elsewhere in the state, such as S-Line design and Ettrick Station improvements in the Richmond to Raleigh Corridor. Many of the projects needed for full buildout of TRV will come later. They will address remaining gaps in the Washington, D.C. to Richmond corridor (Phases 3 and 4) and infrastructure and service improvements within the Richmond to Raleigh and Richmond to Hampton Roads corridors

Figure 1.3 illustrates the location of each of the major capital improvements included in the report and **Appendix A.1** lists each corresponding capital project budget by fiscal year. These projects include Phase 1 and 2 improvements needed to increase the speed, efficiency, and safety of passenger rail along the I-95 corridor from Northern Virginia to

Richmond. They also include a key Richmond Layover Station project needed to improve operations efficiency and service between Main Street rail station and Staples Mill station. However, it does not include all projects that will create a more seamless 3rd rail continuity that will support speeds of 90 miles per hour within the corridor. These service-levels improvements will occur in Phase 3 and 4. Phase 3 will include connecting sidings for a third track to Arkendale, construction of a third track on the Occoquan River crossing, and Woodbridge station improvements. Phase 4 will include the connection of sidings in Spotsylvania for a third track, construction of a third track on the Rappahannock River crossing, and Fredericksburg station improvements (Phase 4). As previously discussed, it also does not include the improvements needed to restore service to Southern Virginia along the S-line. Lastly, it does not include any capital improvements that will eventually be made in the Norfolk corridor.

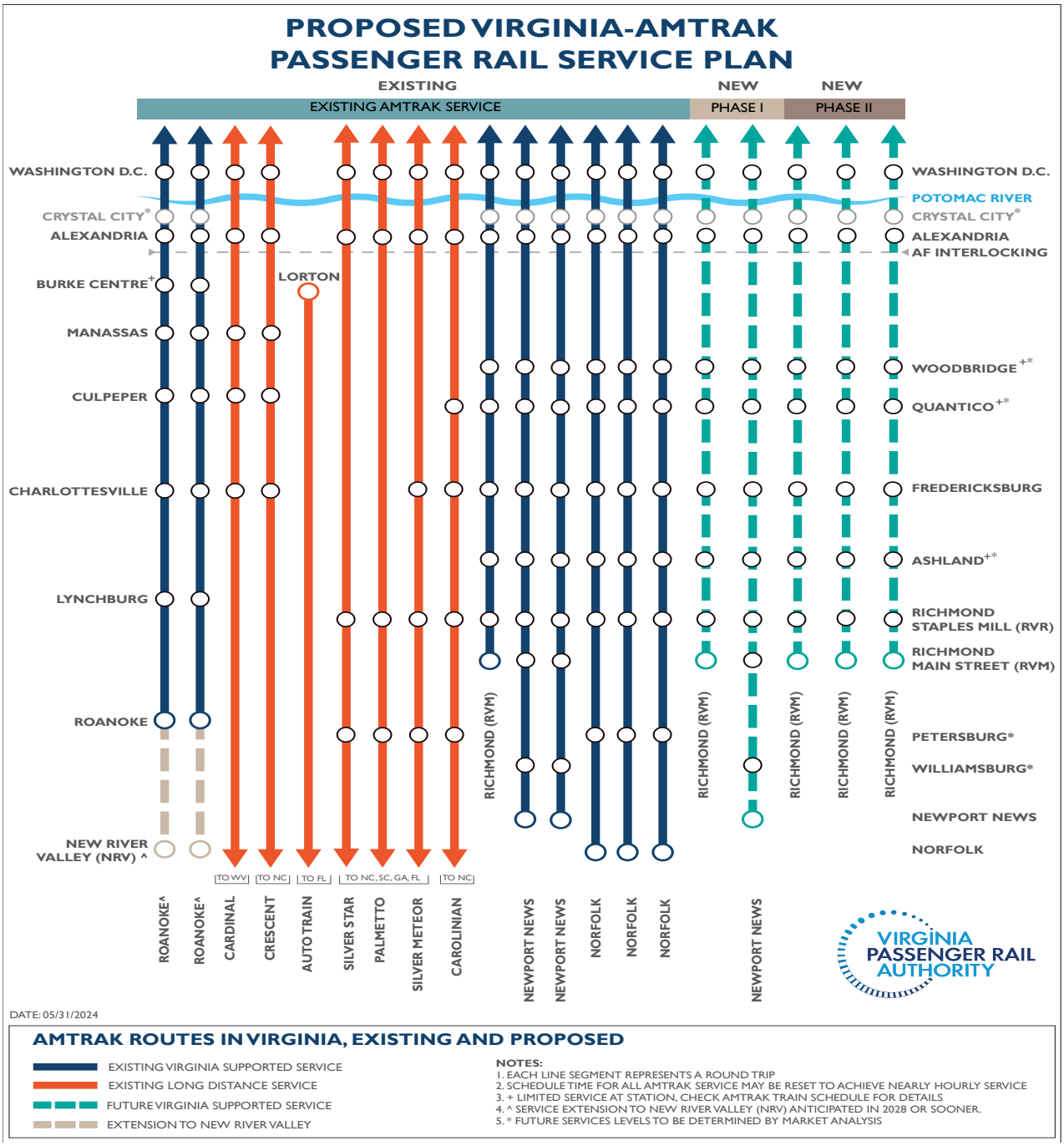
Figure 1.3 TRV Capital Investment Projects



Source: Virginia Passenger Rail Authority

TRV has specific goals with respect to passenger rail expansion. It seeks to increase state-supported Amtrak service in Virginia from the current 8 daily roundtrips to 13 by 2030 and expand Virginia Railway Express (VRE) services to include evening and weekend frequencies. Secondly, it seeks to provide hourly Amtrak service between Richmond and Washington, D.C., extend Amtrak service to the New River Valley, and increase Amtrak service to Newport News. **Figure 1.4** below summarizes the Amtrak passenger trains that are considered part of the operational impacts (solid and dashed lines) and operational expansion impacts (dashed lines) of TRV through 2035.

Figure 1.4 TRV Passenger Rail Service Enhancements



Source: Virginia Passenger Rail Authority

SECTION 2

VIRGINIA PASSENGER AND FREIGHT RAIL CHARACTERISTICS AND TRENDS

This section describes passenger and freight rail transportation characteristics and trends in the Commonwealth. The first subsection presents data on state and regional rail transportation and freight transportation levels with reference to national benchmarks. The next subsection examines factors likely to affect passenger and freight rail transportation in the future.

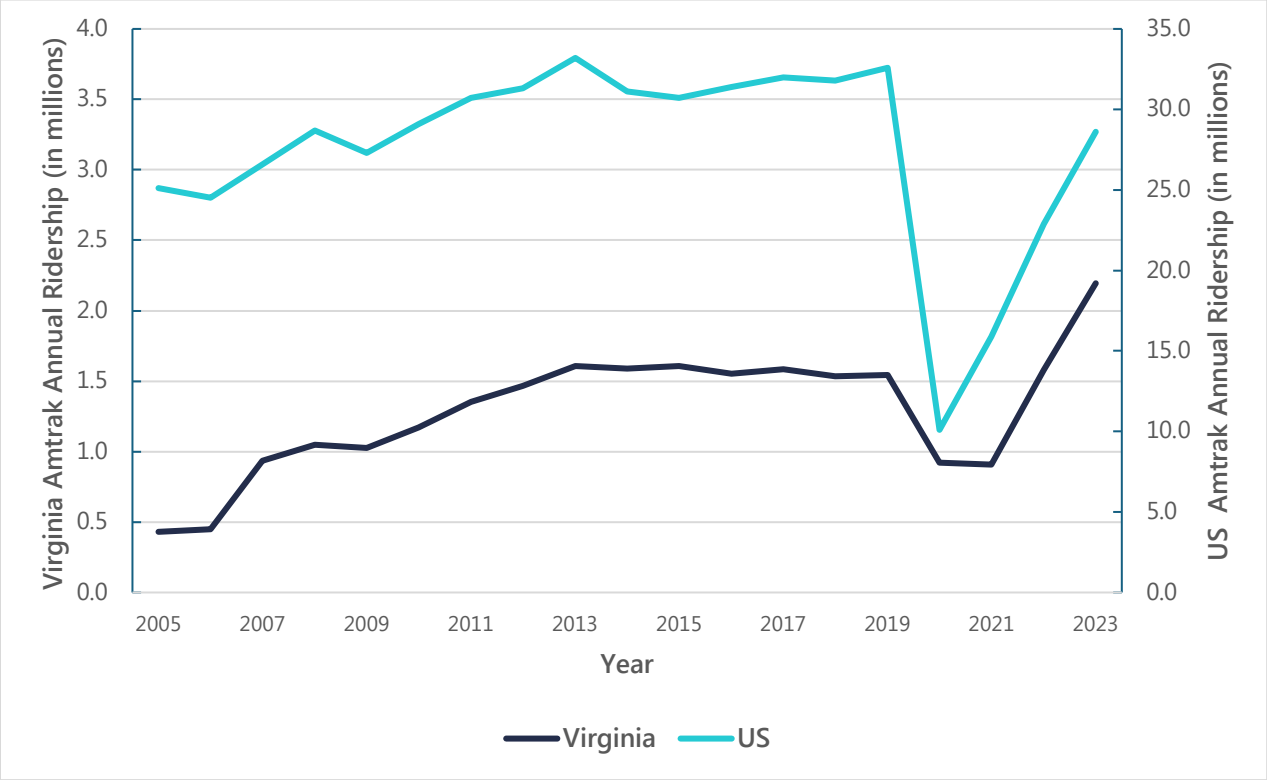
Passenger and Freight Rail Transportation Activity Levels

Intercity Passenger Rail

Amtrak ridership at the national level increased steadily from 2005 to 2013, from 25 million to 33 million annual riders, before declining slightly between 2013 and 2016, and then declining precipitously in 2020 due to the COVID-19 pandemic (see **Figure 2.1**). However, ridership rebounded between 2020 and 2023, surpassing 28 million annual riders in 2023. In the summer of 2024, Amtrak indicated that it expected ridership to top pre-COVID 2019 levels for the first time and reach a record high of above 32.3 million passengers even though Amtrak's system has less capacity than it did in 2019.[ii] The Northeast Corridor (NEC), the busiest route, played a crucial role in this recovery. Ridership on the Northeast Regional service has increased substantially and has already risen past 9 million annual riders, surpassing 2019 levels.

This resurgence in Amtrak ridership has exceeded expectations and may have several explanations. First, with the end of the pandemic and a gradual return to normalcy, recovery can be expected. This has been supported further by a surge in consumer demand for travel and tourism as a result of being couped up for long periods ("revenge tourism") during the pandemic. Rising household incomes from economic expansion have also helped fuel the uptick in travel. Business travel has also picked up from pandemic lows but has not recovered yet to pre-pandemic levels. Second, teleworking rates that were accelerated by the COVID-19 pandemic have been sustained: former short distance daily commuters are now working from more remote locations.

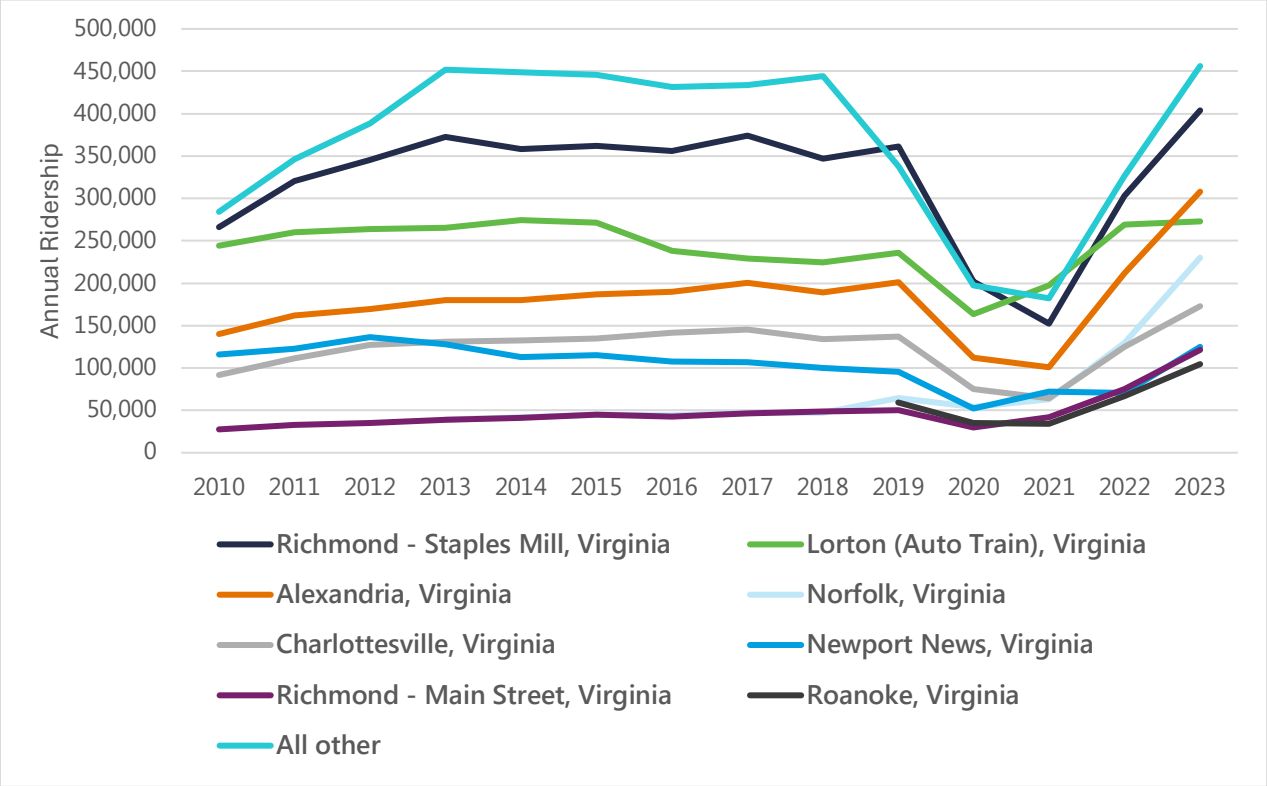
Figure 2.1 Amtrak Annual Ridership, FFY 2005-2023, Virginia and U.S.



Source: Amtrak

Virginia's state-supported Amtrak service also achieved record-breaking ridership in federal fiscal year (FFY) 2023. This is due not only to national-level factors that led to increased ridership across the state's four Amtrak corridors but also expanded services to Norfolk (2022) and Roanoke (2022). Three of the four state-supported corridors have surpassed 2019 ridership levels—Washington-Newport News, Washington-Norfolk, and Washington-Roanoke (see **Figure 2.2**), with the highest growth observed on the Newport News route. The growth in numbers provides further evidence of latent demand for rail travel in Virginia, supported by expanded service options and the role of TRV state-supported assistance since both Roanoke and Norfolk received new daily passenger train services in 2022. As Virginia continues to improve its rail infrastructure and service network, this growth may be supported further by economic, demographic, and other factors described below.

Figure 2.2 Amtrak Annual Ridership for Select Virginia Stations, FFY 2010-2023

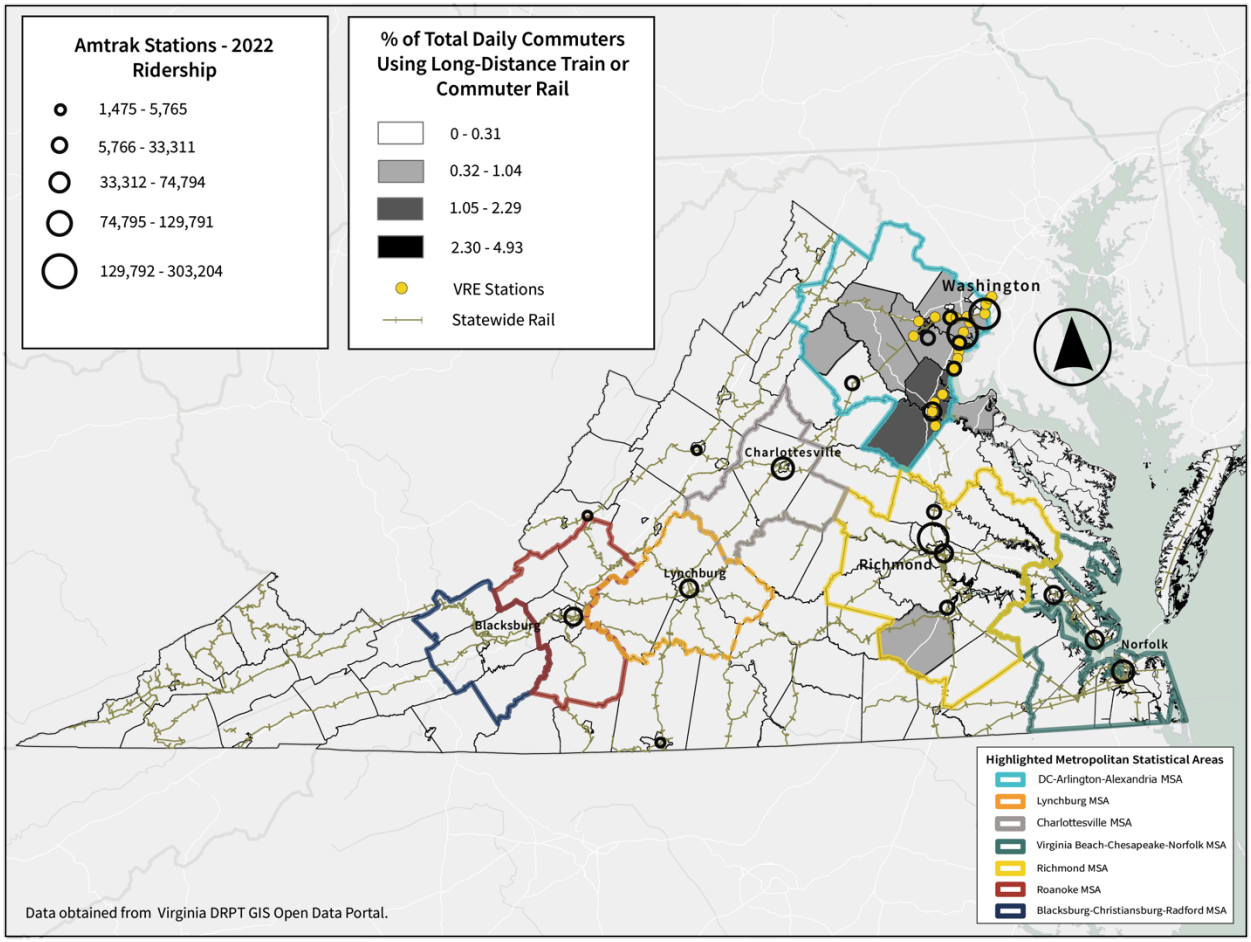


Source: Amtrak

Commuter Rail

The percentage of commuters using passenger rail varies geographically, with higher concentrations in Northern Virginia. This pattern is primarily influenced by the proximity to VRE along with the area's high population density, metropolitan community flows, heavy road congestion, and access to other connecting public transit infrastructure. Fewer than one percent of Virginia commuters rely on long-distance rail or commuter rail for commuting. As **Figure 2.3** shows, the percentage for the VRE corridor is significantly higher, ranging from approximately 2% to 5% for Spotsylvania and Stafford counties, and Fredericksburg, Manassas, and Manassas Park cities. Outside of Northern Virginia, passenger rail services focus primarily on intercity travel for business and leisure purposes.

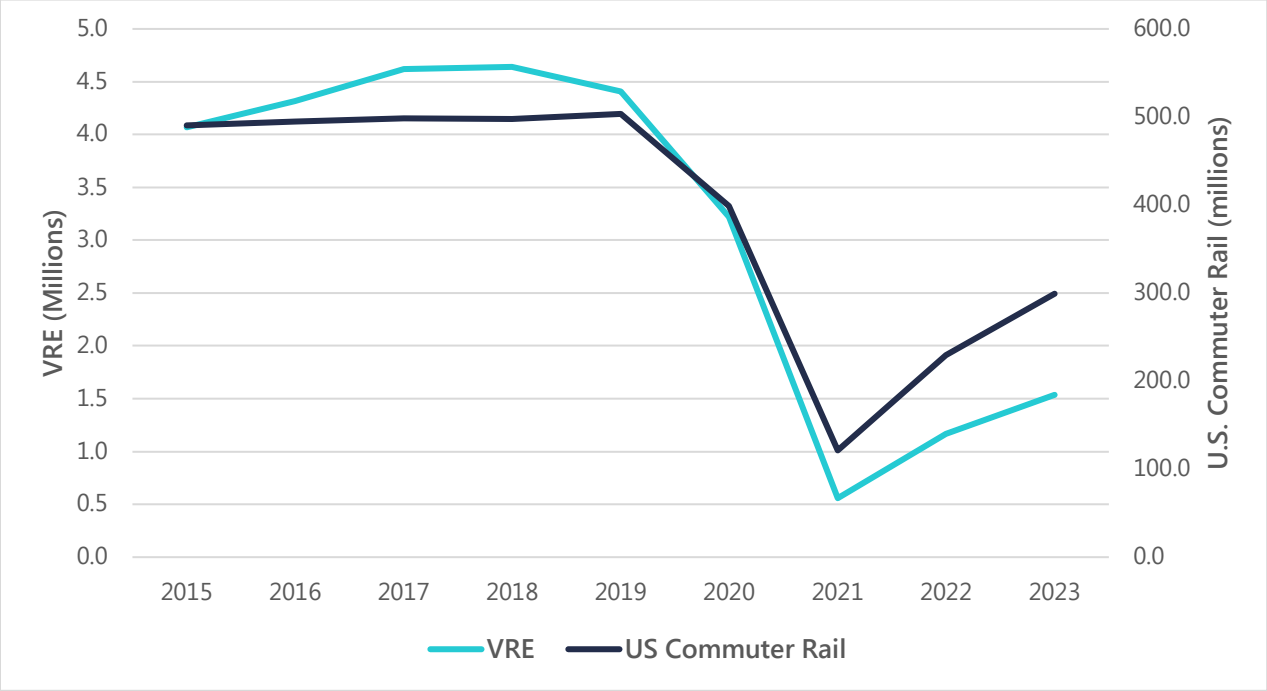
Figure 2.3 Rail Long-Distance or Commuter Rail Commuting by Locality



Source: VDRPT and U.S. Census Bureau, American Community Survey (2018-2022)

Although an important mode for Northern Virginia commuting choices, VRE ridership has experienced stronger headwinds than state-supported Amtrak service. Like commuter rail services elsewhere in the U.S., VRE experienced a large drop-off in ridership beginning in 2020 due to the COVID-19 pandemic. However, ridership has only experienced a modest recovery, with ridership in FY 2023 still less than half of pre-pandemic levels. The persistence of remote work has altered commuter patterns, leading to lower demand for peak-hour services and higher demand for flexibility. VRE has responded to changing travel patterns by adjusting its schedules, such as offering more off-peak service to accommodate changing commuter behaviors. The ongoing improvements under the Transforming Rail in Virginia initiative, such as increased track capacity and more frequent services, should support further ridership growth, although this is occurring from a smaller base and the path to full recovery to pre-pandemic levels remains uncertain.

Figure 2.4 VRE and U.S. Commuter Rail Ridership, FY 2015-2023



Source: VRE and American Public Transportation Association Quarterly Ridership Report
https://www.apta.com/research-technical-resources/transit-statistics/ridership-report/

Freight Rail

The freight rail industry is an important part of the U.S. transportation network, carrying about one-third of the nation's total freight in 2023 by ton-miles (Minn et al. 2022). The composition of rail freight has seen significant changes, with growth in intermodal traffic (i.e., intermodal containers used to transport consumer goods) and declines in coal shipments due to changes in energy regulations and consumption patterns. Major commodities include intermodal shipments, coal and gas, chemicals, agricultural products, and automobiles. Railroads have invested heavily in infrastructure, technology, and equipment, improving efficiency and reliability. In addition, most major railroads have implemented Precision Scheduled Railroading (PSR) in order to streamline operations and reduce costs.

Virginia plays an important role in the national rail network, with two major freight carriers, Class I or "mainline railroads" CSX and Norfolk Southern, serving the state. Nine Class III or "shortline railroads" (Buckingham Branch Railroad; Chesapeake & Albemarle Railroad; Chesapeake Western; Commonwealth Railway; Norfolk & Portsmouth Co. Belt Line; North Carolina and Virginia Railroad; Shenandoah Valley Railroad, LLC; Winchester & Western; and Delmarva Central Railroad) also serve various regions of the state. It also hosts several sizable Port of Virginia facilities that are significant hubs for intermodal traffic, connecting

maritime, rail, and road freight. They include four marine terminals—the Norfolk International Terminals (NIT), Portsmouth Marine Terminal (PMT), Newport News Marine Terminal (NNMT), and Virginia International Gateway (VIG)—and one dry port, Virginia Inland Port. Key commodities include coal, lumber, agricultural products, scrap metal, paper, chemicals, and transportation equipment. Bulk/breakbulk commodities, such as coal and roll-on/roll-off cargo like transportation equipment, are more likely to be transferred by rail than truck while containerized cargo is more likely to travel by truck (OIPI 2022). Virginia faces freight congestion issues in certain areas, especially around Virginia urban centers, such as Northern Virginia and Hampton Roads, which can affect freight rail efficiency. At the same time, Virginia and freight carriers have invested in rail infrastructure, including projects like the Atlantic Gateway and improvements to intermodal facilities like the Virginia Inland Port in Front Royal (which connects to I-81) and the Richmond Terminal (which connects to I-95) to enhance freight capacity and efficiency. TRV investments such as the Long Bridge Project will also significantly improve freight rail operation speed, reliability, and efficiency in the state. These improvements will make rail a more competitive choice for containerized cargo shipments, enabling freight rail to remove more trucks from Virginia roadways, reducing congestion and saving wear and tear on highways.

Factors Affecting Future Passenger Rail Ridership and Freight Rail Volumes

Passenger rail ridership is closely related to urbanization, demographics, consumer tastes, and public transportation policies. These factors will shape rail passenger ridership in the coming decades.

First, the COVID-19 pandemic led to a large shift in telecommuting and remote work which will not soon be erased. Many workers have relocated to smaller cities and towns that are more remote from their workplaces, though many firms have embraced flexible work arrangements that require workers to spend some time in the office. Moreover, recent research suggests that traveler interest has shifted more in favor of High-Speed Rail (HSR) after the COVID-19 pandemic (Pan and Rooze 2023). This trend will likely support the continued growth of intercity passenger rail services like Amtrak. VRE, in contrast, caters mostly to short-distance, work-related trips within the Washington, D.C.-Arlington-Alexandria metropolitan area. As more employees continue to work from home or adopt hybrid schedules, the demand for daily commuter rail services is likely to be reduced.

Second, future age and demographic trends suggest promising opportunities for the growth of both commuter (VRE) and intercity or regional passenger rail services (Amtrak).

Recent generations, including Millennials (born 1981-1996) and Generation Z (born 1997-2021), are more likely to live in urban areas where they have better access to public transit, show less interest in car ownership than earlier generations, and have a greater affinity for public transportation, ride-sharing and active transportation (walking, cycling) (Zhang and Li 2022). Moreover, Baby Boomers, who have had high automobile ownership rates are likely to continue to drive less as they age and may favor more train travel.

Third, advances in locomotive technology and ongoing investments in rail infrastructure, such as those that are part of the Transforming Rail in Virginia initiative, will help improve service frequency, reliability, and speed, making passenger rail more competitive with other modes of transportation. Furthermore, public policy is likely to be more supportive of public transportation in the future as the need to reduce vehicular traffic from roadways to ease congestion, decrease emissions, improve passenger safety, and reduce the growing expenses of highway maintenance become more salient issues. Federal and state governments may continue to support the development of rail networks as part of efforts to reduce carbon emissions and offer greener alternatives to cars and planes.

Rail freight activity and employment are influenced by several variables, including the level of economic activity, particularly industrial production; the health of commodity markets such as coal and agriculture; and growth in global trade (Cook 2020). Because some bulk commodities such as coal, chemicals, and stone are more economical to transport by rail, changes in those industries can have a disproportionate impact on rail transportation. Railroads are also in competition with other transportation modes based on costs, speed, and reliability of delivery, as well as other considerations. Technology or efficiency improvements in non-rail industries or fuel cost decreases, which tips the balance in favor of trucking, because of its greater flexibility, can also affect the industry.

The viability and growth of freight rail services in the U.S. and Virginia are likely to be influenced by various trends in the economy, technology, and public policies in the future. The fragmentation of global supply chains due to geopolitical conflicts with China and tariff policies may reduce international trade and cause supply chain disruptions that alter the demand for rail services. On the other hand, reshoring U.S. industrial activity in manufacturing sectors could spur demand, which positively impacts freight rail volumes. Increasing urbanization in the U.S. continues to pressure road infrastructure, creating opportunities for rail to absorb more freight transportation capacity. Continued advancements in rail automation, AI, and the Internet of Things (IoT) are likely to further transform route planning and logistics, improve scheduling, and reduce delays, which could lower operational costs. Public policies like Virginia's Transforming Rail in Virginia initiative are likely to improve freight competitiveness in Virginia by expanding the capacity and reliability of rail freight along Virginia corridors.

SECTION 3

SOCIOECONOMIC EFFECTS OF PASSENGER RAIL IMPROVEMENTS

This section reviews scholarly publications and the gray literature that address the economic, social, and environmental effects of rail improvements. The first subsection describes public and private transportation options, the effect of passenger rail availability on modal choice, and barriers to passenger rail use. The second subsection explores the theoretical underpinnings of passenger rail's effect on economic development, drawing from urban and regional economic theories that link transportation improvements and regional growth. It also reviews the empirical findings about this relationship. The third subsection examines empirical findings on the relationship between rail improvements and local property prices. The fourth subsection looks at land use and accessibility effects. The fifth subsection examines other social, economic, and environmental impacts of rail improvements.

Many empirical studies have been published that examine the socioeconomic, environmental, social, and geographical effects of rail transportation. Studies of rail impacts during the 19th century show that the nation's early railroad system (which carried large volumes of freight and many passengers) helped shape national growth and development during the post-bellum period. However, the findings of more recent rail expansion projects are often more nuanced because the improvements studied are also more incremental than systemic. Study findings also vary widely as the studies differ significantly in terms of the specific mode examined (e.g., light, heavy, commuter, HSR), country examined, geographical scale (e.g., national, regional), time period, methodology, and other study features, making generalizations difficult. For example, a relatively large number of studies examine specifically HSR expansion in Asia (mainly China) and Europe where considerable efforts have been made to develop and improve such systems that in the U.S. remain embryonic.[iii] In the U.S., studies are more likely to examine the effect of local transit improvements, including light rail, metro, and sometimes commuter rail, where system improvements have been more common.

Fortunately, several systematic-reviews and meta-analyses of this vast literature have been conducted that allow researchers to more easily generalize. A meta-analysis is a statistical method that analyzes the features and results of multiple studies on a topic. By combining the results of multiple studies, the analysis is able to increase the sample size and the ability to detect patterns, trends, and estimates of effects that may not be clear in individual

studies. Moreover, a meta-analysis can provide more robust and generalizable conclusions about a particular research question.

One downside of these meta-analyses is that few include studies of intercity passenger rail in their samples, with HSR, light rail, heavy rail, and commuter rail studies most prevalent. Inferences for intercity passenger rail and TRV state-supported rail services are drawn from these studies because they are the primary empirical evidence available, and there are substantial similarities between intercity passenger rail and these other rail modes. First, intercity rail has similar infrastructure, including dedicated tracks, restricted access points such as stations, and maintenance facilities to these other rail modes. Second, its economic mechanisms of stimulating economic activity by improving accessibility, boosting property values, encouraging transit-oriented development, and reducing congestion is also similar to intercity rail. Third, similar to other rail modes, passenger rail decreases travel time, provides cost savings for commuters, and offers a reliable alternative to automobile or air travel. These benefits translate into both direct and indirect economic effects, like increased productivity and decreased environmental costs, which are important in rail studies. Fourth, intercity rail is similar to HSR in that it services longer distances. Its economic effects for urban nodes, employment, and population may align with the findings of high-speed rail studies. Fifth, intercity passenger rail stations serve similar purposes to commuter and heavy rail stations and may be expected to promote development in the vicinity of stations and influence the size, shape, and configuration of urban areas in similar ways. For these reasons, the findings of such studies can be used to better understand how the TRV initiative might affect Virginia in different ways.

Passenger Rail Availability and Modal Choice

Significant differences exist in the characteristics of various private transportation and public transit services, including the types of locations usually served, average speed or range of speeds, cost per passenger mile, and ease of substitution with passenger rail.

High-Speed rail is usually considered an interregional train service. It typically serves major, well-connected cities or regions over long distances and is known for its speed and efficiency, significantly reducing travel times compared to conventional intercity rail service, automobiles, and buses. Currently such service is widely available in parts of Europe, China, and Japan. In the U.S., only Amtrak's Acela service between Boston and Washington, D.C., which can attain speeds of 150 miles per hour and Brightline in Florida, which has a maximum speed of 125 miles per hour, currently qualify as genuine HSR services. Because they often share tracks with freight, intercity rail services operate below HSR speeds and offer less reliability than HSR.

The USDOT FRA High-Speed Intercity Passenger Rail (HSIPR) program currently defines the following categories of rail service based on maximum speeds attained. Core Express Services travel at speeds of 125-250+mph and serve the dense and populous urban regions. Regional services attain speeds of 90-125mph and often serve mid-sized to large cities. Feeder services attain speeds of up to 90mph connecting communities to the passenger rail network and providing a foundation for future corridor development. Using these definitions, TRV will eventually allow many corridors to reach regional service levels while some segments will still offer feeder services.

Other rail options include commuter rail, metro/subway, and light rail. Commuter rail provides regional services by connecting suburbs and exurban areas to city centers, typically during peak commuting hours. It often offers a balance between speed and capacity, serving a specific regional market. Metro/subway rail primarily serves dense urban environments, focusing on high-capacity and high-frequency service within cities. It also bridges the gap between urban transit and conventional rail, often serving suburbs and less dense urban areas.

Other transportation options can serve as substitutes but sometimes complements to various rail transportation modes. Bus transportation can serve a wide range of locations, including rural areas, due to the extensive road network. It is also generally the most cost-effective mode on a per-passenger-mile basis but offers slower speeds and less comfort for long distances. Buses can vary in size, from small shuttle buses to large motor coaches. Air Transportation is the fastest mode for long distances, but typically more expensive per passenger mile. Auto transportation is valued for its convenience and flexibility. It can reach almost any location accessible by road but can be costly in terms of fuel and maintenance.

Although it is intuitively obvious that offering more passenger rail ridership options should entice commuters, business travelers, tourists, and others to choose passenger rail more often, it has been only recently that researchers have applied ex-post empirical methods to data on travel behavior to validate this finding. For example, Wang et al. (2023) provide a systematic review of 16 studies and meta-analysis of 8 studies. Results from this analysis indicate that the introduction of light and heavy rail transit significantly increased rail's modal share and significantly decreased the modal share of automobiles and buses, and also reduced vehicle miles traveled (VMT). Zhang, Wan, and Yang (2019) examine the effect of HSR on airport usage. For China, this study finds that the introduction of HSR negatively impacts air traffic for both short-to-medium distance routes and long-distance (more than 900 km) routes. However, the latter is not found for other (European and other markets). HSR is likely a substitute for some air travel, particularly within 300km and 700km travel ranges, while sometimes a complement (1,000 km or more) in market economies with more developed transit systems. In those instances, new HSR can potentially expand the

catchment areas for larger airports where ground transportation service costs were previously more expensive/slower. The introduction of HSR can also induce additional demand for transit services. One review of ex-post studies finds that 10-20% of ridership is induced, including increased ridership resulting from transit-induced changes in population, land uses, and economic growth (Givoni and Dobruszkes 2013).

Blainey, Hickford, and Preston (2012) examine the types of barriers to passenger rail usages. These include 1) hard barriers, items usually accounted for in transport demand models that affect all travelers and usually command the attention of transportation planners and funding for transit improvement projects, 2) soft barriers that vary based on traveler, trip and place characteristics[iv], and 3) complementary barriers that are related to "travel choices of people's activity and lifestyle choices and of wider cultural and economic factors."[v]

Hard barriers include 1) travel time, 2) trip reliability, 3) service frequency, 4) interchange difficulty, 5) network limitations, 6) cost, 7) station access and egress (e.g., station car park availability, distance to the railway station, attractiveness, signage), 8) ticketing complexity and inter-availability, 9) structural car dependence (e.g., travel planning requirements, privacy, financial savings, feeling of control), 10) land use patterns (i.e., dispersed development pattern and abundant parking encouraging car use), 11) government policy, 12) safety, and 13) inherent unsuitability of trips for rail. It is important to note that TRV is designed to mitigate many of these physical impediments to passenger rail usage (see **Table 3.1**). For example, capacity improvements, additional rail provision, and right-of-way acquisitions will improve speeds and reduce competition with freight trains, thereby reducing travel time and improving reliability. Station improvements will increase access, comfort, and ease of ticketing.

Table 3.1 Barriers to Passenger Rail Usage and TRV Improvements

Barrier	TRV Improvements
Travel time	Rail capacity improvements (e.g., 3rd and 4th rail improvements, ROW acquisition) to improve speed to 90-125mph along some sections.
Trip reliability	Rail capacity improvements to remove conflicts with freight rail; signaling improvements.
Service frequency	Increase the number of daily state-supported trains to 13 by 2030.
Interchange difficulty	Station improvements, including parking additions and multimodal improvements.
Network limitations	Extension of rail service to New River Valley.
Cost	Efficiency improvements (e.g., removal of deadhead movement due to new Richmond Layover Facility) and greater scale economies may reduce marginal rail transportation costs.
Station egress and ingress	Station and multimodal improvements.
Ticketing complexity	New stations (e.g., NRV) offer on-site ticketing.
Land use patterns	Passenger rail may contribute to more transit-oriented development (TOD) in some areas.
Government policy	Diverse revenue streams including automotive toll revenues provide support for passenger rail usage.
Safety	Additional rails, signaling improvements, and grade separations reduce conflicts between freight and vehicular traffic.
Inherent unsuitability of trips for rail	TRV speed and service improvements increase catchment areas for longer distance trips.

Regional Economic Growth and Development

Transportation improvements can influence economic growth and development in several different ways (Weisbord 2008). First, it can improve the ability of regions and industries to trade. Second, it can improve transport reliability and reduce cargo loss/perishability. Third, it can expand labor and product market catchment areas and catalyze production and distribution scale economies. Fourth, it can stimulate agglomeration economies or productivity improvements through improved access to more specialized and diverse inputs

and products/services. These changes may be related to further changes in the urban economic geography, land uses, and land and property values (Knowles and Ferbrache 2016), which are examined in the next sections.

The effects of rail may differ across industries and geographies (Alstadt, Weisbrod and Cutler 2012; Loukaitou-Sideris et al. 2013). The sensitivity of industry employment and population to rail transportation changes can also differ. Analysis of historical data from the introduction of railroads in the late 1800s on U.S. county growth indicates that railroads had a statistically significantly positive effect on production, employment, and population (Donaldson and Hornbeck 2016). Today rail freight is more likely to include commodities with a high weight-to-value ratio, thereby improving access for producers and consumers of bulk commodities, such as coal and agricultural goods. More recent studies of intercity passenger rail services indicate that they influence the location of the population more than employment (Talebian, Zou, and Hansen 2018).

Transportation improvements may have both generative and distributive effects (Redding and Turner 2013). Generative effects are more likely to be experienced by locations along the transportation corridor improvement and specifically upon particular competitive nodes along the corridor, including highly urbanized nodes where the initial improvements stimulated additional agglomeration improvements (Loukaitou-Sideris et al. 2013). Negative displacement effects may be experienced at off-corridor locations, non-connected locations along the corridor or corridors with smaller populations, and less competitive nodes along the corridor (Zhang, Wan, and Yang 2019; Loukaitou-Sideris et al. 2013). Improvements within metro areas, such as rail transit systems, have been found to affect population location vis-à-vis central business districts while commuter rail is associated with greater population growth in suburban areas (Redding and Turner 2014).

The empirical literature on links between transportation improvements on economic growth and development is vast and too large to adequately summarize here without the assistance of organized literature reviews. These papers include comparisons of the economic effects of improvements for various individual transportation modes, including road, air, water, and rail transport without distinguishing explicitly between passenger and freight transportation movement. It also consists of research that examines the effects of competing rail mode transport improvements such as light rail, metro/subway, commuter rail, and heavy rail. This literature generally looks at the post-construction economic effects of such improvements. There is less controversy over the impact of the construction stage since local construction expenditures are known to have a temporary effect on local construction employment and supporting industries. However, there may also be some disruptive effects of construction on local economies such as small retail and service businesses (Tornabene and Nilsson 2021).

Two meta-analyses have looked at the effect of various types of transportation improvements, grouped into general transportation modes of road, rail, etc. An analysis of 33 studies by Melo, Graham, and Brage-Ardao (2013) indicates that a 10% increase in transportation infrastructure investment is associated with a 0.5% increase in productivity. However, road improvements are associated with greater productivity effects compared to other types of transport (e.g., rail, airport, port/ferry). Another meta-analysis (Roberts et al. 2020) of 97 papers published between 2000 and 2018 concerned with urban transportation projects finds that large transport infrastructure has a statistically significant effect on economic welfare and equity. Their study suggests that other transport modes were more likely to report statistically significant results compared with roads and railways.

An important element of transportation's effect on economic growth is through transport-induced agglomeration effects. Agglomeration economies stem from increased productivity that results from improved access and connectivity between firms, workers, suppliers, and consumers. Firm productivity increases due to access to a larger and more diverse labor pool, more specialized suppliers, and increased firm interactions (NAS 2014). This connectivity is typically measured using two different accessibility type measures: effective density (i.e., the effective population density provided by improved labor market catchment areas and market potential measures. The results of the Melo and Graham (2017) study indicate that public transit, including commuter rail, light rail and heavy rail, and busses, increases urban agglomeration economies while roads weaken it. According to NAS (2014), the evidence for such effects is restricted to particular modes, distance ranges, and trip purposes. While there is ample research that urban ground transportation, such as commuter rail, contributes to agglomeration effects, there is less research available to support the existence of these effects for long-distance modes, such as intercity passenger rail.

Cheng and Chen (2022) review the socioeconomic impact studies of HSR based on 242 academic publications and conduct a meta-analysis on a subset consisting of 45 studies. They find that HSR investment has a positive effect on economic growth in terms of economic performance measures such as GDP, gross output, and employment. Also, evidence suggests that HSR can contribute to labor mobility.

Their meta-analysis of the economic impacts of HSR investment found that the impact of HSR on the economy, in general, is more substantial for different economic metrics, regional characteristics, and study research design features. Their findings on the former elements are of great interest here. The economic impact of HSR was found to be relatively higher if the dependent variable is measured in personal income, employment, or population rather than GDP. Also, the impact of HSR on total factor productivity (TFP) is higher than GDP. Furthermore, the impact of HSR was found to be relatively higher if the dependent variable

is measured in terms of gross regional product (GRP), which suggests that the impact of HSR is found to be relatively higher at the regional level than at the national level and in urban areas compared to rural areas. These findings imply that HSR results in some displacement effects that favor competitive urban nodes.

Talebian, Zou, and Hansen (2018) provide the only study examining state-supported Amtrak intercity passenger rail services. This study examined rail service effects on local population and employment at both county and city levels of California supported rail services beginning in 1976 using a pre-treatment period of 1950-70 and post-treatment period of 1980-2010. They find that state-supported Amtrak stations affect county and city population growth in the long term, but civilian employment growth effects are more limited. These results suggest that state-supported Amtrak services are more likely to attract people than jobs. In contrast, when applying the same methods to Illinois Amtrak stations, the authors find small effects that are not statistically significant.

These results collectively suggest that the TRV initiative is likely to somewhat reshape Virginia's urban geography. It is expected to have positive impacts on the localities that are traversed by rail corridors, with the economic impacts fairly concentrated at larger urban nodes served by rail stations along routes in Northern Virginia, Richmond, Williamsburg, Hampton Roads, Charlottesville, Lynchburg, and Roanoke with economic impacts elsewhere more limited. As a new terminus, Blacksburg-Christiansburg is also likely to realize more positive economic development effects than elsewhere in the New River Valley.

Property Values

A substantial amount of scholarly literature examines the effect of rail transportation on land use and property values. Rail transportation of various types has generally been found to have some localized positive effects on land, commercial buildings, and residential prices.

Railroad transportation improvements can affect property prices in two different ways. Urban bid-rent theory explains how the price and demand for real estate vary with distance from an attraction. In monocentric models, the main attraction is the central business district (CBD) where a significant amount of employment is concentrated. Households and businesses bid up property prices in close proximity to the CBD in order to reduce their transportation costs. The effect of transportation improvements to the CBD is to reduce the cost of traveling to the CBD from any given location. This will tend to flatten the land rent gradient and increase the size of the commuter shed, which will increase suburban area land values. These land prices will tend to be higher at particular access nodes along a route, such as a passenger rail station, since intermodal transportation costs will be the lowest in

these locations. On the other hand, train proximity may also provide a local disamenity in the form of train noise and air quality (Clark 2005). These local environmental disamenities may be capitalized into property prices, resulting in lower prices for properties nearby. The net effect of these two competing influences is unknown a priori. However, close proximity to a railroad station would offer an attraction effect that offsets the disamenity effect while the latter might dominate elsewhere along rail corridors.

Three systematic reviews/meta-analyses of ex-post studies have been published in this area within the last two decades to resolve these and other empirical questions about the role of rail transportation improvements on property prices.

Debrezion, Pels, and Rietveld (2007) provided the earliest attempt to identify factors that account for the varied impact of rail improvements on estimated property values. Using 73 empirical results from multiple U.S. studies, the authors find that property value impacts vary along several dimensions, including land use, rail type, road accessibility, and study methodological features. They find that commercial property prices increase more than residential property prices within ¼ mile (i.e., walking distance) of railway stations but that residential property impacts are higher at longer distances. They also investigate whether particular types of railway stations have differential impacts as consumers may more highly value certain service qualities such as service frequency, speed, geographical coverage, and comfort (as represented by light, heavy, commuter rail transit services and rapid bus transit). Empirical results indicate that commuter railway stations exhibit greater property value impacts than either light rail or heavy rail/metro stations. Lastly, mode competition represented by highway accessibility to the station has a negative impact on property values.

Mohammad et al. (2013) provided another literature review and meta-analysis of 23 North American, European, and Asian studies based on 103 empirical results. The studies they review generally show positive gains in land/property values in close proximity to stations for most rail systems, although some studies find negligible or negative local effects. These impacts vary geographically with property price impacts generally higher in East Asian and European cities compared to North American ones, perhaps due to the greater availability of mass transit.

According to the meta-analysis, property value findings vary along several dimensions, including land use type, rail service type, rail system longevity, distance to stations, geographical location, road accessibility, and study research design characteristics. Price impacts are found to be significantly lower for property values compared to changes in land values, possibly due to the greater intensive development potential of the latter. Commercial land/properties tend to exhibit significantly higher value changes compared to residential

land/properties. Commuter rail also has higher property value impacts than light rail and metro/subway. They also find that property price impacts are highest within intermediate station distances of 500-805 meters. Similar to Debrezion, Pels, and Rietveld (2007), the authors find that additional road accessibility negatively affects property values.

A recent meta-analysis by Rennert (2022) examines a substantially larger group of studies from North America, Europe, Asia, and Oceania with more recent vintage, starting with a group of 200 studies conducted between 1970 and 2022. The meta-analysis of 66 results from dozens of studies includes more explanatory variables than the other two meta-analyses, including variables representing demographic, housing, and transit service features (e.g., frequency, cost, reliability). They find that commuter rail and heavy rail have higher property price effects than light rail. Transit service characteristics are also important. Higher transit costs reduce property value impacts while the number of connections improves them. These findings suggest that consumers are more likely to value proximity to less costly rail transit options that offer greater geographical reach.

Collectively, these studies have several common conclusions that are relevant for evaluating the potential impact of TRV on property prices. First, railway improvements generally have positive property value impacts, but the property value impacts can vary based on land use, railway distance, and rail type. Commuter rail service tends to produce a higher impact than light rail and metro/subway. These findings may be due to the fact that commuter rail has higher quality or performance characteristics (e.g., speed, frequency, range) than these other modes. Second, rail station proximity is most important for commercial properties, though overall maximum impacts are sometimes observed at intermediate distances, particularly for residential properties, possibly because of a local nuisance effect due to noise, pollution, or crime perceptions (Rennert 2022). Land/property value effects from rail infrastructure can generally be found up to 1,000 m (0.6 mi) for residential areas and 400 m (0.25 mi) for commercial areas. Greater accessibility for non-transit modes such as highways has a negative impact on railway infrastructure property impacts. The availability of alternative modes nearby may reduce the advantage of rail access, holding other things constant.

Land Use and Accessibility Benefits

Land use and accessibility benefits may result from intercity passenger rail improvements. Local and regional land use, when effectively planned around rail systems, can increase system usability and accessibility. These benefits may accrue on top of other direct and indirect economic benefits described elsewhere.

Increasing capacity and speed makes rail travel more attractive and useful for travelers, but rail systems do not operate in a vacuum. All transportation systems derive their value from linking people with destinations and activities, whether jobs, tourism, health care, shopping, or otherwise. These benefits are often described as "accessibility" (Levine 2020). Increasing accessibility requires ensuring that land use and development patterns are thoughtfully distributed around a rail system so that rail systems are an attractive option for travelers seeking to reach a range of destinations (Houston et al. 2015). Local connectivity from stations to the surrounding area is essential as well, providing access that can compete with intercity alternatives such as driving or flying.

Rail investments can increase accessibility across station areas, resulting in a range of potential benefits. Intercity passenger rail improvements can attract firms and employment around station areas. Wenner and Thierstein (2022) examine high-speed rail in Europe and find that companies are more likely to relocate near HSR station areas for the accessibility benefits, as well as "image" effects. While similar studies are not available for the United States context, other research on intracity rail such as light rail and commuter rail finds similar results, with station areas showing increased employment 5-10 years after opening (Schuetz et al., 2018), increased share of regional jobs within one mile of rail stations (Nelson 2017), and some evidence of new business starts in the knowledge, service, and retail sectors (Credit 2018). High-speed rail can also increase locational attractiveness for households, resulting in local population growth around stations if local planning supports growth (Wenner and Thierstein 2022). Dong (2016) finds similar results for intracity light rail in Portland, Oregon in conditions where vacant land is available for development, and policies are established to encourage growth. Finally, rail improvements may improve labor productivity in the vicinity of train stations. Transit station areas in the Beijing, China region demonstrate increased labor productivity in a range of sectors including retail, wholesale, accommodations, culture, sports, and entertainment (Lyu et al. 2020). It is likely that network effects encouraged by a more comprehensive rail system can concentrate activities in station areas, resulting in overall increased productivity in those areas.

Many of the studies that find benefits from accessibility around rail stations underscore the critical importance of planning and policy. Multiple studies find that, local and regional planning are essential for increasing the benefits of rail transportation (Dong 2016; Lyu et al. 2020; Rennert 2022). Most property and growth benefits of rail transportation tend to accrue in the vicinity of stations or require strong connections through local transportation options. Transforming Rail in Virginia serves a wide range of communities across the Commonwealth, including already dense urban areas in Northern Virginia and Richmond, as well as suburban and town locations. Each locality should consider how they can structure future development to best take advantage of the benefits of increased speeds and

capacities. Employment and population growth, if desired, are likely within a mile or so of station areas. All localities, however, will benefit from network effects whether they seek to accommodate further growth or not.

Social and Environmental Effects

Although the effects of rail transportation improvements on modal choices, economic growth, and property prices have received enough study to enable researchers to compile systematic literature reviews and conduct meta-analyses to explain patterns in the findings, the research on other topics such as social and environmental outcomes is somewhat sparse. These include physical activity and health, entrepreneurship and innovation, and the environment. This more nascent ex-post literature is still suggestive that rail initiatives such as TRV would have beneficial effects in these areas as well.

Physical Activity and Health

The wider availability of passenger rail services, like other public transit modes, may have a salutary effect on individuals' physical activity and community health outcomes. Much of the evidence surrounds improvements in local public transit, such as light rail, and may be more suggestive than conclusive evidence in favor of intercity passenger rail service expansion. Passenger rail services could hypothetically improve physical activity and health outcomes in several ways. First, since passenger rail stations are located at fixed points, users need to walk or cycle to the access points. Transit usage will tend to stimulate walking or cycling, reduce sedentary time, and reduce obesity (Patterson et al. 2019; Ravensberger et al. 2023). Second, introducing public transportation may alter land use patterns and the built environment that further encourages walking and bicycling. Evidence suggests that such changes in community design can encourage more active lifestyles (Wali et al. 2024). Third, shifting from automobiles to rail can reduce air pollution, which could in theory reduce the incidence of respiratory diseases (like asthma) and improve cardiovascular health. Public transportation use can also possibly reduce stress compared to driving in heavily congested roadways, which may also contribute to improved mental well-being. Finally, rail improvements could improve access to health care facilities and services for disadvantaged residents or those located in more remote or rural regions.

Entrepreneurship and Innovation

Although increased entrepreneurship and innovation would also be reflected in improved economic outcomes such as economic development and property prices, these qualities are often pursued independently in order to create the conditions for more dynamic and

sustainable economic development. Some evidence suggests that rail improvements can contribute to improved firm formation and creativity through the channels of improved connectivity, talent attraction, and urban revitalization (Sanchis-Guarner, Szumilo, and Vernet 2024). Improved rail links between regions and cities can lower transportation costs and expand access to customers and suppliers. It can also make it easier to attract skilled workers and a more diverse workforce that can stimulate innovation and creativity. Faster passenger rail services may facilitate more face-to-face interactions between entrepreneurs, investors, and innovators from different areas, which creates more opportunities for networking and collaboration that foster new idea generation. The development of rail stations can lead to urban revitalization that supports new business formation to serve commuters and tourists, such as restaurants and retail stores. Urban areas with good public transport and environmentally-friendly transport options are also attractive for members of the creative class and tech startups.

Several ex-post empirical analyses suggest that improved rail access improves entrepreneurship in the vicinity of rail stations. For example, Sanchis-Guarner, Szumilo, and Vernet (2021) find that new rail stations in the United Kingdom improve self-employment closest to new stations with rates 0.84 percentage points higher close to a station than 7 km away. In a study of the impact of the Phoenix light rail system on new firm formation, Credit (2018) finds that self-employment and business startups increased in the vicinity of the new transit system by 88% in the knowledge sector, 40% in the service sector, and 28% in retail trade, though the effect diminishes over time. Studies of HSR in China have also identified evidence for increased entrepreneurship at the regional level, although the effect is strongest for large urban areas (Lan, Hu, and Wen 223; Ma, Niu, and Sun 2021).

Environment

Introducing passenger rail services to a region can have beneficial environmental impacts. The mechanisms for these effects include reducing emissions and energy usage and influencing land use patterns. Passenger rail uses less energy and produces fewer emissions per passenger mile than automobile travel. Moreover, travelers who switch to rail travel can reduce road congestion, lowering emissions from idling and stop-and-go driving. Rail transit availability can also contribute to more compact, high-density, mixed-use development (i.e., transit-oriented development or TOD) which reduces urban sprawl and preserves green spaces, natural habitats, and agricultural land. Lastly, rail transportation has a smaller footprint than roads and highways, which can reduce stormwater runoff that carries pollutants such as oil, road salts, and heavy metals into nearby water bodies.

Ex-post research on the topic of pollution emission is limited partly because of the technical difficulties of measuring the contribution of local factors to ambient pollution levels. A study

of the introduction of HSR in in China by Chen et al. (2024) indicates that the HSR was associated with per capita reductions at the city-level of three pollutant emissions, including particulate matter, industrial wastewater, and industrial sulfur dioxide emissions. However, the mechanism for these improvements was changing industry structure and technological factors rather than transportation mode shifting behavior. Some research, however, suggest that the introduction of passenger rail can foster higher density or transit-oriented development patterns, but here too the ex-post research is limited (Wang, Lu and Levinson 2022).

SECTION 4

ECONOMIC IMPACT AND SOCIAL COST-BENEFIT ANALYSIS

This section describes the modeling frameworks used to quantify the economic effects of the TRV for Virginia. They include economic impact analysis and social cost-benefit analysis. The first subsection describes the properties of each approach, highlighting their differences and commonalities. It also identifies facets of rail passenger economic impact and benefits captured by the subsequent analyses. The second subsection describes the IMPLAN economic impact model used, distinguishing between capital investment and operational impacts. The final subsection describes the social cost-benefit analysis developed for VPRA to analyze the costs and benefits of Phase 2 improvements, examining various levels for travel time savings, safety benefits, and environmental effects and its ramifications for computing additional economic impacts and wider economic effects (WEBs) of TRV.

Economic Impact Analysis and Social Benefits Analysis

Economic impact analysis is a method for evaluating the effects of a project, policy, or program on a region's economy. It uses data on the economic size and characteristics of an individual project or program, such as the level of capital investment or spending on increased employment payroll and other business inputs and examines how the money spent as a result of the project circulates throughout the economy and affects the broader economy. For example, the TRV initiative will result in increased capital investment for various rail infrastructure improvement projects and will also create additional passenger rail services that will create new spending on employee payroll and purchases of goods and services. Economic impact analysis can measure the increased economic activity resulting from this additional spending. It would also measure the induced effects of increased consumer spending due to more labor income for workers employed as a result of the initial shock. Each dollar spent has a multiplicative effect on the broader economy as a result of the ripple effect from the initial spending. The method may use several different economic metrics to gauge this economic effect, including employment, output, and income. Also, the effect of the additional economic activity on government tax revenues can be computed.

Social Cost-Benefit Analysis (SCBA), in contrast, evaluates the broader societal effects of a project, policy, or program. It tabulates resulting costs and benefits, including non-market benefits, over the lifetime of the project. The non-market benefits may include items such as improved quality of life, environmental benefits, reduced congestion, and improved health and safety. These non-market (i.e. non-priced) benefits are assigned monetary values based on economic benefits such as revealed or stated preference methods.[vi] For example,

infrastructure and service improvements resulting from the TRV initiative will result in passenger travel time savings for existing passengers and new passengers using Amtrak. It will also reduce the number of vehicle miles traveled by passengers who formerly traveled by automobile, reducing congestion and air pollution. Rail travel is also generally safer than automobile travel. So, switching to rail travel can reduce the number of accidents and injuries. These benefits can be valued in monetary terms, added, and discounted over time to provide a single metric of the value or benefit of a project.

Economic impact analysis and social cost-benefit analysis are both used to evaluate projects, policies, and programs for decision-making. They provide different perspectives on the usefulness and desirability of a particular project, policy, or program. The main purpose of economic impact analysis is to understand the effect of a project or program on the economy while SCBA tries to assess the overall net value to society.

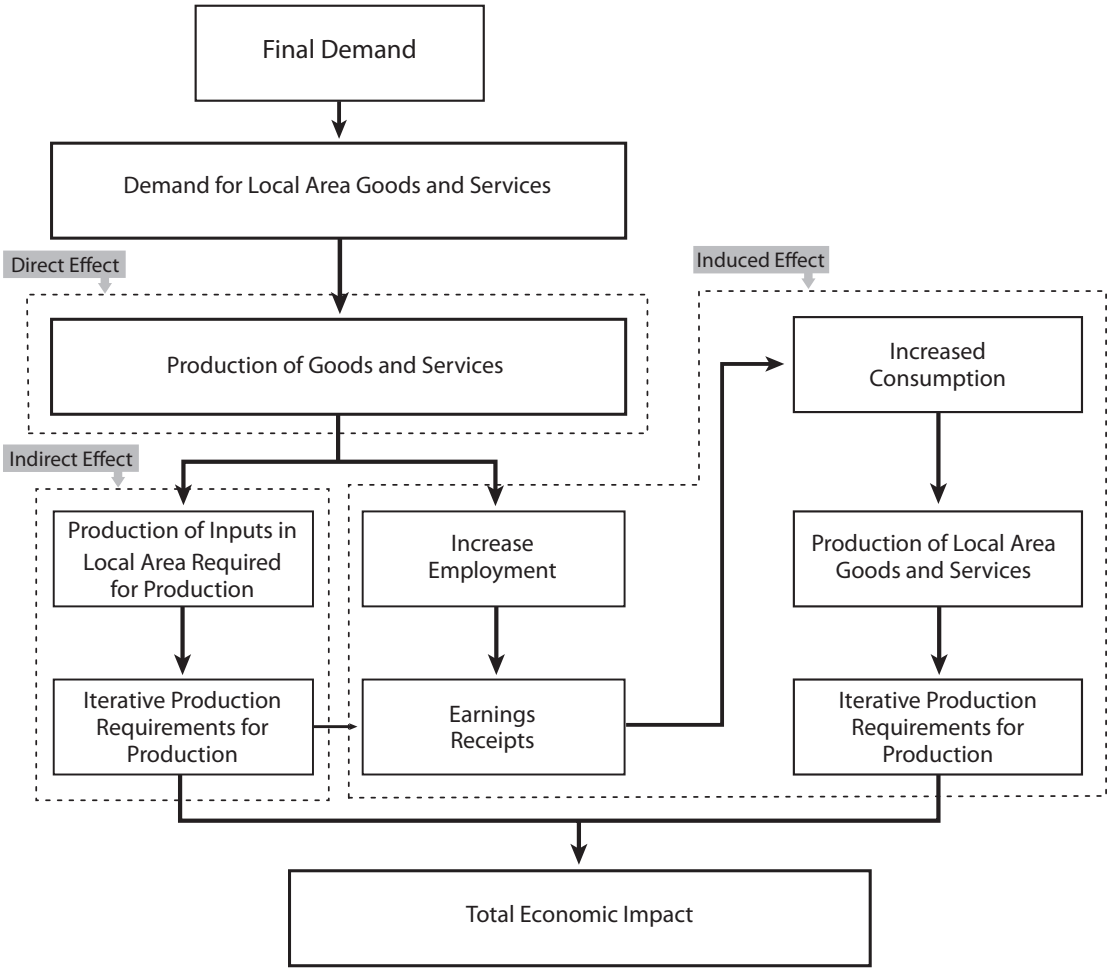
Economic impact analysis can be affected by some of the same transportation system changes accounted for in SCBA. For example, transportation enhancements can result in operational cost advantages, productivity boosts, and safety gains, which result in consumer or business savings. These savings can be repurposed for other spending and incorporated in economic impact analysis as is now captured in some transportation economic impact models such as TREDIS (Weisbrod, Mulley, and Hensher 2016; TREDIS 2023). For example, within SCBA, transportation improvements can lead to operational savings, which are realized from reduced vehicle operating costs (e.g., fuel, maintenance). These cost savings free up resources for businesses and individuals, allowing funds to be redirected towards other purposes, such as consumption and investment, which may boost economic activity in a region if the resources are more likely to be sourced from within the region. Since the main automobile expenditure is imported gasoline, redirecting this spending to other goods and services will likely lead to more net local spending. Transportation improvements can also be linked to productivity improvements, such as time savings and improved reliability, which increase passenger and freight transportation efficiency. Improved productivity, in turn, lowers business costs and allows them to increase profits, lower prices (increase markets), and increase investment (TREDIS 2023). These actions can lead to increased output, sales, and job creation. Furthermore, safety benefits from transportation improvements result from reductions in crashes, injuries, and fatalities. These savings are usually monetized based on avoided medical costs, emergency services, lost productivity, and human capital costs (which can be quantified using values like the Value of Statistical Life). Within economic impact analysis, reduced accidents can result in avoidance of worker earnings losses. This would be equivalent to an income boost when compared to a status quo scenario without the transportation improvements.

IMPLAN Economic Impact Modelling

This study uses IMPLAN, an input-output model, to gauge TRV's economic contribution to the Commonwealth of Virginia and seven metropolitan areas. Input-output analysis produces industry economic multipliers that show how changes in employment or expenditures affect a regional economy. TRV-related expenditures made in the region are counted as direct injections into the local economies. Linkages with other industries in the area mean this initial injection has further stimulative effects that result from the purchases of goods and services and payments to employees. The stimulus causes a "multiplier effect" that results when money is re-spent in the local economy.

The total impact of this activity consists of three parts: a direct effect, an indirect effect, and an induced effect (see **Figure 4**). The direct effect refers primarily to the economic impact of TRV-related spending in the region. The indirect effect refers to the economic impact that results from purchases of goods and services in the region. The indirect effect measures the cumulative change as a result of TRV-related purchasing of goods and services within the region as well as the subsequent rounds of firm goods and service purchases needed to supply other local producers. For example, state-supported Amtrak passenger services may purchase janitorial and waste collection services from area businesses, which causes a "ripple effect" on the local economy when money is re-spent by these businesses on equipment, supplies, business services, and other goods and services from local businesses. These businesses spend a portion of their sales revenues on their supplies and services from other local firms which, in turn, purchase a portion of their supplies and services from other local firms. This cascading sequence of spending continues until the subsequent rounds of spending dissipate due to leakages that result from saving or spending outside the area. The sum of these cascading rounds of inter-industry purchases constitutes the indirect effect. The final component of total impact (the induced effect or induced impact) is attributable to worker household income and spending. For instance, businesses in the supply chain pay workers from local households for their labor. These households then purchase goods and services from area firms who, in turn, receive a portion of their labor, material, and service inputs from within the region. Again, leakages occur at each round due to purchases of goods and services outside the state. The induced effect is the sum of the industry impacts associated with these household purchases.

Figure 4.1 Economic Impact Diagram



IMPLAN (Impact Analysis for PLANning), used for the impact analysis part of this study, is an industry standard input-output model that has been used in many economic impact studies, including state and regional studies of passenger rail services and improvements (AECOM 2019; Duncan and Wakefield 2014).

The study used multi-regional input-output (MRIO) analysis to estimate the regional and state and economic and government revenue impacts of TRV capital and operational spending. The analysis was conducted using IMPLAN Online version 7.5 software released on November 9, 2023. MRIO analysis measures the economic impacts of spending within the principal study region as well as impacts on other areas that are linked with the principal study area. Because of these linkages, spending leakages into other regions cause economic impacts that cause leakages from those areas back into the principal study region. Eight regional models representing (a) the seven metropolitan areas that are served/will be served

by TRV service expansions covered in this report and (b) a residual region constituting the other state localities.

The first stage of estimating economic impact was to obtain information on TRV-related capital and operational spending in Virginia. The next stage was to assign the spending to each of the study metro areas and the residual Virginia region. The next stage involved mapping these inputs onto appropriate IMPLAN sectors using multi-regional input-output (MRIO) analysis with IMPLAN Online software. The third stage involved running the IMPLAN model and generating the economic impact and government revenue impact results.

Results are presented for four different economic measures (employment, labor income, value-added, and output) and one fiscal measure (government revenue) in 2021. Employment is measured in terms of person-years of employment. A person-year of employment is a job of one year in duration. Employment includes full-time and part-time employment as well as self-employment and is measured by place of work. Total sales or industry output, which is the total value of industry production during a period, measures sales of intermediate inputs for use in production as well as sales of products to final consumers. Value-added is a subset of total industrial output and is the most commonly used measure of economic activity. It reflects only sales to final consumers and, therefore, avoids the double counting that occurs when intermediate inputs are included. Value-added is the concept behind gross domestic product (GDP) and can be compared to the GDP numbers provided by the Bureau of Economic Analysis for states and metropolitan areas. It can also be represented as total factor income plus indirect business taxes. Labor income represents the component of value-added that flows to workers and business owners in the form of employee compensation and proprietary income. Local government revenues include taxes, fees and fines, and charges for service.[vii]

The method for assembling the input data for these components and manner in which these data inputs were mapped onto IMPLAN are described in further detail in **Appendix B**.

TRV Benefit-Cost Analysis

A Benefit-Cost Analysis (BCA) developed for the Virginia Passenger Rail Authority was designed to evaluate rail infrastructure projects and service improvements projects in Virginia associated with Transforming Rail in Virginia Phases 1 and 2 that closely align with the projects and service enhancements described elsewhere in this report (VPRA 2023). The BCA assesses the value of proposed projects and operational enhancements by quantifying their expected benefits and costs. The analysis accounts for both capital and operational costs associated with the rail project and benefits that accrue from the rail operational

improvements and diversion of vehicular traffic from roadways. The analysis uses a specific discount rate of 7% per USDOT guidelines to calculate the net present value (NPV) of costs and benefits over a 30-year analysis period.

The analysis relies on input data on project-specific parameters, such as projected ridership, travel time, accident rates, emission factors, and cost estimates. These parameters were derived from a variety of sources including: USDOT (2023) (e.g., discount rate, value of travel time savings, vehicle operating costs, cost per injury/fatality, pavement costs), Amtrak (ridership projections), Replica (average driving speeds), Virginia Department of Transportation or VDOT (vehicular composition, crash data), California Life-Cycle Benefit/Cost Analysis (Cal-B/C) model (vehicular emission rates), and Victorian Transport Policy Institute (monetary value of transportation diversity per-VMT). Ridership projections used in the analysis of state-supported route ridership increases were obtained from the study. These ridership projects accounted for the build-out of TRV improvements and passenger rail service enhancements described in this report.

The BCA includes several different benefit categories that can be linked with state-funded passenger rail improvements. The following categories are used in this report:

- **Passenger Productivity**. This benefit category accounts for the value of time-saving for passengers due to improved rail services. It computes delay savings for new passenger rail riders. With the availability of new rail services, drivers on congested corridors can switch to taking the train instead of sitting in traffic, and passengers can use this time to work while traveling. The value of this productive time is calculated for business travelers based on average hourly wages derived from Payscale.
- **Vehicle Operating Cost Savings**. This category measures cost reductions in vehicle operation when trips are diverted from road to rail. Trips shifted from driving to another mode, like the train, lead to savings on fuel and vehicle maintenance. These savings are calculated per vehicle mile traveled (VMT) for trips that switch from driving to rail.
- **Crash Reduction.** This category estimates the decrease in accidents, injuries, and fatalities due to shifting traffic from roads to safer rail modes. Crash reduction benefits were calculated per vehicle mile traveled (VMT) by applying the VMT savings to average crash rates in the project area. The number of crashes by different crash severity levels were estimated, and the reduction in crashes was monetized based on USDOT guidelines. The value of avoided crashes represents the crash reduction benefit.

- **Vehicle Emissions Reduction.** This category measures decreases in greenhouse gases and air pollutants due to modal shifts. Reduced VMT due to a switch to passenger rail usage leads to lower vehicle emissions. Emissions reductions were calculated per VMT reduced. Emission rates for pollutants, including carbon monoxide (CO), carbon dioxide (CO2), nitrogen oxides (NOx), sulfur oxides (SOx), and volatile organic compounds (VOCs) were calculated using environment damage costs from the 2022 California Life-Cycle Benefit/Cost Analysis (Cal-B/C) for each emission.
- **External Highway Use**. This category evaluates the reduction in road congestion, noise mitigation cost savings, and reduced wear-and-tear to existing road pavement due to reduced VMT resulting from passenger rail improvements. External highway use benefits were calculated on a per-VMT basis.
- **Transportation Diversity**. This category represents the option value of having more transport services available. In particular, the availability of another travel mode provides consumers more options for choosing the most appropriate mode for a specific trip, improves transportation network resilience by diversifying the number of modes available, and improves equity and accessibility. These benefits were calculated per VMT using research from the Victorian Transport Policy Institute (2022) based on information on public transit subsidies and travel data.

The analysis does not take into consideration wider economic benefits (WEBs), a benefit category increasingly used in SCBAs of transportation projects. Wider economic benefits are positive economic impacts that go beyond the user and non-user benefits traditionally captured in BCA. A key factor contributing to WEBs is agglomeration externalities. Agglomeration externalities stem from increased productivity that results from improved access and connectivity between firms, workers, suppliers, and consumers. Transportation improvements enhance these connections and contribute to agglomeration economies by facilitating interactions between workers and firms (termed 'static' agglomeration effects) that: a) enhance knowledge transfer and spillovers, b) facilitate more specialized labor markets, c) facilitate more specialized production inputs, and d) reduce job search costs and improve labor market matching through more dynamic mechanisms (termed 'dynamic' agglomeration effects) such as a) firm and worker relocations, b) land use changes, and c) increased density (Graham and Gibbons 2019).[viii] According to recent research, these WEBs can represent an additional 5-30% of the total user benefits (e.g., time savings, reduced vehicle operating costs, and safety improvements) (Tveter 2020). The percentage of WEBs relative to user benefits can vary significantly depending on the specific project scope, regional economic characteristics, existing transport network characteristics, and the type of rail improvements. Conventional intercity passenger rail improvements may yield relatively lower WEBs when compared to some other modes, like roads, urban transit, and HSR for

several reasons. First, conventional passenger rail improvements may not reduce travel times as significantly as HSR or road projects, limiting the magnitude of agglomeration and productivity benefits. Second, intercity passenger rail passes through many low-density and rural regions. In areas with low density, rail improvements might not generate substantial agglomeration benefits compared to improvements, such as urban rapid transit and commuter rail, in close proximity to major urban areas.

The VDRPT Commonwealth Rail Fund Benefit-Cost Analysis (BCA) Tool computes WEBs for freight and passenger rail improvements similar to the intercity passenger rail improvements that are most core to the first two phases of TRV. These are computed as 5% of user benefits, including travel time savings, safety benefits and reduced transportation costs (VDRPT 2021).

SECTION 5

ECONOMIC IMPACT RESULTS

This section presents the results of the economic impact of TRV-related economic impacts, including employment, output, value-added, labor income, and government revenue for the Commonwealth of Virginia using a Multi-Regional Input Output (MRIO) model. It also disaggregates the results by regions that are affected directly by TRV capital investment and passenger rail service enhancements.

Virginia Results

TRV will result in nearly $4.7 billion in capital spending in the state on over 20 individual funded projects over the next 7-10 years, primarily within the I-95, Southeast, and Western Rail Corridors. **Table 5.1** shows the statewide economic impact of this spending. The projects will support 22,100 jobs, $1.8 billion in labor income, over $2.4 billion in value-added, and $4.1 billion in output (property acquisitions as part of Right-of-Way transactions do not constitute new output, so this part of capital investment expenditures is not reflected in output figures). Most of the jobs will be created in the construction industry. Direct spending will support the creation of 11,588 additional jobs in the state, $817 million in labor income, nearly $1.6 billion in value-added, and $2.6 billion in industrial output through indirect and induced effects for a total economic impact of 33,688 jobs, over $2.6 billion in labor income, over $4.1 billion in value-added, and $6.7 billion in output. These figures represent cumulative economic activity over the FY 2025-FY 2034 period. Job numbers are expressed in terms of job years. Therefore, since the development and construction timeline for the TRV projects spans a period of at most 10 years, one can expect an average of 3.369 total jobs each year over the FY 2025-FY 2034 period to be supported by capital investment. For comparison purposes, employment grew by an average of 34,300 jobs in the Commonwealth each year over the FY 2019-FY 2024 period. The TRV economic impact would represent 10% of that baseline employment creation.

Ongoing passenger rail operational and maintenance expenditures are another important channel of TRV economic impact. All spending associated with state-supported routes in FY 2035 (termed "TRV Operations") is estimated to support 371 direct passenger rail industry jobs, $40.2 million in labor income, $95.6 million in value-added, and $211.1 million in output (see **Table 5.2**). When additional input purchases and payments to labor are accounted for through indirect and induced impacts, the total impact rises to 1,062 jobs, $89.4 million in labor income, $186.5 million in value-added, and $361.4 million in output.

These are annual and recurring economic impacts in contrast to the capital investment impacts which end when construction finishes.

When the focus of operational impact is only the additional expansion from increases in passenger trains as a result of increased service levels (termed "TRV Operations Expansion") due to the TRV infrastructure and service level improvements, an additional 71 jobs $7.6 million in labor income, $18.2 million in value-added, and $40.3 million in output is estimated (see **Table 5.3**). The total economic impact of the expansion is 198 jobs, $16.8 million in labor income, $35 million in value-added, and $68.2 million in output. These too are annual and recurring economic impacts.

Table 5.1 Virginia Capital Investment Impacts, Cumulative FY 2025-2034

Impact	Employment	Labor Income	Value-Added	Output
Direct	22,100	$1,818,009,296	$2,434,684,872	$4,112,797,877
Indirect	4,562	$388,967,109	$719,379,309	$1,265,734,208
Induced	7,026	$428,074,647	$847,248,984	$1,347,564,329
TOTAL	**33,688**	**$2,635,051,052**	**$4,001,313,165**	**$6,726,096,413**

Table 5.2 Virginia TRV Operations Economic Impacts in FY 2035, Direct, Indirect, Induced and Total Impacts

Impact	Employment	Labor Income	Value-Added	Output
Direct	371	$40,187,488	$95,563,751	$211,111,348
Indirect	419	$34,136,713	$60,737,547	$100,553,947
Induced	272	$15,095,344	$30,181,224	$49,757,684
TOTAL	**1,062**	**$89,419,546**	**$186,482,522**	**$361,422,979**

Table 5.3 Virginia TRV Operations Expansion Economic Impacts in FY 2035, Direct, Indirect, Induced and Total Impacts

Impact	Employment	Labor Income	Value-Added	Output
Direct	71	$7,582,126	$18,185,115	$40,315,700
Indirect	78	$6,416,219	$11,397,769	$18,840,551
Induced	49	$2,753,582	$5,519,756	$9,064,511
TOTAL	**198**	**$16,751,927**	**$35,102,640**	**$68,220,762**

The additional economic activity created by TRV will also generate additional federal, state, and local government (mainly tax) revenues (see **Table 5.4**). Using information from IMPLAN, the capital investment activities of TRV will generate an additional $104.4 million in local, $139.2 million in state, and $587.8 million in federal government revenue. The operations of state-supported routes will generate $2.2 million in local, $5 million in state, and nearly $23 million in federal government revenues. Operations expansion, which represent approximately 20% of total operations in FY 2035, will generate $393 thousand local, $918 thousand state, and $4.3 million in federal government revenues.

Table 5.4 Total Government Revenue Impacts, (Operations FY 2035; Capital Investment Cumulative FY 2025-2034)

Government Level	Operations	Operations Expansion	Capital Investment
Local	$2,195,574	$393,101	$104,430,998
State	$5,011,686	$917,719	$139,166,025
Federal	$22,938,287	$4,301,573	$587,790,231
TOTAL	**$30,145,547**	**$5,612,393**	**$831,387,253**

Regional Breakdown of Total Economic Impacts

Table 5.5 shows a breakdown of the capital investment total economic impacts by metropolitan area affected. Capital investment spending is associated with four metro areas: the Washington-Arlington-Alexandria MSA where the bulk of I-95 capital improvements occur, including the Long Bridge Project and Franconia-Springfield Bypass project;

Blacksburg-Christiansburg MSA where the New River Passenger rail investments are concentrated; the Richmond MSA where Hanover Third track, Richmond Layover Facility, and other improvements occur; and the Charlottesville MSA where some corridor right-of-way acquisition occurs. The Virginia portion of the Washington-Arlington-Alexandria MSA is responsible for the bulk of the total economic impact, including 29,506 jobs, over $2.3 billion in labor income, $3.6 billion in value-added, and $5.9 billion in output. These represent approximately 90% of the total statewide impacts for those metrics. Second is the Richmond MSA with 1,879 jobs, $136 million in labor income, $214 million in value-added, and $369 million in output, representing approximately 5% of the total economic impact on those measures. Finally, representing 2% of the total impact is the Blacksburg-Christiansburg MSA with 896 jobs, $44 million in labor income, $69 million in value-added and $143 million in output. The balance is attributable to the rest of the state (including Charlottesville MSA).

Table 5.5 Capital Investment Total Impacts by Region, Cumulative FY 2025-2034

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	896	$44,324,460	$68,747,052	$143,108,713
Charlottesville MSA	23	$1,451,462	$2,613,666	$5,389,611
Richmond MSA	1,879	$135,816,424	$214,237,785	$369,387,711
Washington-Arlington-Alexandria MSA	29,506	$2,373,381,108	$3,566,290,123	$5,910,720,692
Rest of Virginia	1,385	$80,077,598	$149,424,539	$297,489,686
TOTAL	**33,688**	**$2,635,051,052**	**$4,001,313,165**	**$6,726,096,413**

Tables 5.6 and **5.7** show the total economic impact of operational spending. Here the effects are more widespread because metropolitan areas that were not directly affected by capital projects over the period were at least indirectly affected by service area expansion. For example, a new passenger train for Newport News will also serve the Northern Virginia and Richmond metropolitan areas along the route. The largest economic footprint for state-supported services is in the Washington-Arlington-Alexandria metro area (362 jobs, $31.7 million in labor income, $66.6 million in value-added, and $128.5 in million output) followed by the Richmond metro area (323 jobs, $28.6 million in labor income, $56.9 million in value-added, and $105.8 million in output) and Virginia Beach-Newport News region. The net impact of passenger rail service enhancements resulting from TRV Phase 1 and 2 (see Table

5.7) will be largest in the Washington, D.C. metropolitan area (81 jobs, $7.1 million in labor income, $14.9 million in value-added, and $28.9 million in output) followed by the Richmond metropolitan area (57 jobs, $5.0 million in labor income, $10.0 million in value-added, and $18.7 million in output). The Blacksburg-Christiansburg MSA receives an economic impact of 14 jobs, $1 million in labor income, $2.2 million in value-added, and $4.6 million in output because of the extension of existing rail services from Roanoke to the New River Valley with rail station and layover facility activities.

Table 5.6 TRV Operations Total Economic Impacts by Region in FY 2035

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	15	$1,102,561	$2,335,788	$4,831,221
Charlottesville MSA	42	$3,531,764	$7,194,363	$14,329,752
Lynchburg MSA	51	$3,836,933	$8,685,556	$17,261,795
Richmond MSA	323	$28,595,066	$56,865,946	$105,776,947
Roanoke MSA	31	$2,314,103	$4,947,447	$9,859,290
Virginia Beach-Newport News MSA	98	$7,564,093	$15,508,058	$30,659,816
Washington-Arlington-Alexandria MSA	362	$31,777,676	$66,589,128	$128,545,695
Rest of Virginia	141	$10,697,349	$24,356,236	$50,158,462
TOTAL	**1,062**	**$89,419,546**	**$186,482,522**	**$361,422,979**

Table 5.7 TRV Operations Expansion Total Economic Impacts by Region in FY 2035

Region	Employment	Labor Income	Value-Added	Output
Blacksburg-Christiansburg MSA	14	$1,046,252	$2,234,481	$4,631,195
Charlottesville MSA	1	$95,117	$179,602	$359,952
Lynchburg MSA	1	$89,642	$243,587	$437,324
Richmond MSA	57	$5,040,424	$10,040,082	$18,708,993
Roanoke MSA	2	$123,303	$285,380	$545,921
Virginia Beach-Newport News MSA	12	$923,147	$1,874,546	$3,699,086
Washington-Arlington-Alexandria MSA	81	$7,096,680	$14,923,121	$28,851,974
Rest of Virginia	30	$2,337,363	$5,321,840	$10,986,317
TOTAL	**198**	**$16,751,927**	**$35,102,640**	**$68,220,762**

Blacksburg-Christiansburg MSA

The Blacksburg-Christiansburg MSA is home to Virginia Tech, a major research university. The area's economy is heavily influenced by education, research, technology, and manufacturing. The metropolitan area had an estimated population of 183,586 in 2023 and is projected to grow by an additional one percent by 2035 (to 185,580). Virginia Tech's presence will create an opportunity to significantly increase Amtrak ridership, particularly among students and university employees who travel between Blacksburg and larger cities outside the region such as Washington, D.C.

The New River Valley project will restore passenger rail service to the region that was discontinued in 1979. A capital investment of $86.67 million will fund infrastructure to make that expansion possible. It will include track and bridge improvements, passenger station improvements, a layover facility, and other improvements. The new passenger station will be served twice daily by Amtrak Virginia Northeast Regional passenger rail services that currently terminates at Roanoke.

TRV New River Valley capital investment expenditures are expected to support 611 direct jobs, labor income of $30.1 million, value-added of $40.6 million, and output of $86.6 million. The total impact, including indirect and induced impacts from capital spending is 896 jobs, $44.3 million in labor income, $68.7 million in value-added, and $143.1 million in output.

The economic impact of all state-supported rail passenger operational spending in FY 2035 is estimated to support 6 direct jobs, $677 thousand in labor income, $1.5 million in value-added, and $3.3 million in output. The total economic impact of TRV expansion is 15 jobs, $1.1 million in labor income, $2.3 million in value-added, and $4.8 million in output. Since the service is new, the economic impact of operations spending will be of similar magnitude to operations expansion.

Table 5.8 Blacksburg-Christiansburg Metro Area Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$65,496
Unemployment Rate, 2023	2.9%
Poverty Rate, 2022	19.1%
Population, 2023	183,586
Population, 2035	185,580
Gross Domestic Production, 2022	$9,516,233,000
Total Employment, 2022	95,460
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington to New River Valley (Route 46 – VA state-supported)	2
Ridership by Station FY 2023	
Blacksburg	--
Estimated O&M Expenditures	
Total	$3,318,396
Additional	$3,318,396
Capital Projects/Expenditures	
New River Valley Passenger Rail Project	$8,100,000
Capital Improvements--Bridges	$1,500,000
Capital Improvements-Other	$11,600,000
Cambria Platform and Radford Layover	$65,400,000
TOTAL	**$86,600,000**

Table 5.9 Blacksburg-Christiansburg Metro Area TRV Economic Impacts

Economic Impact of Capital Investment				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	611	$30,148,731	$40,551,080	$86,600,000
Indirect	146	$8,565,430	$15,904,069	$34,909,489
Induced	140	$5,610,299	$12,291,902	$21,599,224
TOTAL	**896**	**$44,324,460**	**$68,747,052**	**$143,108,713**

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	6	$676,624	$1,533,529	$3,318,396
Indirect	5	$276,387	$474,628	$937,187
Induced	4	$149,550	$327,631	$575,638
TOTAL	**15**	**$1,102,561**	**$2,335,788**	**$4,831,221**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	6	$676,624	$1,533,529	$3,318,396
Indirect	5	$242,573	$422,600	$823,743
Induced	3	$127,056	$278,352	$489,056
TOTAL	**14**	**$1,046,252**	**$2,234,481**	**$4,631,195**

Charlottesville MSA

Charlottesville is home to the University of Virginia. Its economy is heavily influenced by education and healthcare with a growing technology startup sector. It is also a cultural and historical destination that attracts a substantial number of tourists. The region has experienced steady population growth resulting from the attraction of both young professional and retirees. Its population is projected to grow by an additional 7% by 2035 (from 231,377 in 2023 to 247,973 in 2035).

Passenger ridership at the Charlottesville rail station was 172,871 in FY 2023. The city's strong ties to education and tourism and technology sector growth present opportunities to increase further student, tourist, and business traveler ridership, particularly with the expansion of higher-speed and enhanced service options made available by TRV.

TRV will result in some capital spending and expand passenger rail operational spending and capital spending in the Charlottesville MSA. Although no major capital projects are planned for the region, a small amount of planning and development expenditures connected to right-of-way acquisition along I-64 is anticipated. State-supported routes will support approximately $9.2 million in regional spending in FY 2035 when expanded traffic is realized due to capital improvements examined in this report.

TRV capital expenditures are expected to support 2 direct jobs, labor income of $173,673, value-added of $272,422 and output of $427,385. The total impact, including indirect and induced impacts from capital investment spending are 23 jobs, approximately $1.5 million in labor income, $2.6 million in value-added, and over $5 million in output. The economic impact of all state-supported rail passenger spending is estimated to support 16 direct jobs, $1.9 million in labor income, $4.2 million in value-added, and $9.2 million in output. The total impact is 42 jobs, $3.5 million in labor income, $7.2 million in value-added, and $14.3 million in output. The total economic impact of TRV operations expansion is one additional job, $95,117 in labor income, $179,602 value-added, and $359,952 in output.

Table 5.10 Charlottesville Metro Area Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$83,910
Unemployment Rate, 2023	2.6%
Poverty Rate, 2022	12.6%
Population, 2023	231,577
Population, 2035	247,973
Gross Domestic Production, 2022	$17,190,033,000
Total Employment, 2022	164,934
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington to New River Valley (Route 46 - VA state-supported)	2
Cardinal (long-distance)	3 trains per week/ in each direction
Ridership by Station FY 2023	
Charlottesville	172,871
Estimated O&M Expenditures	
Total	$9,166,606
Additional	$152,909
Capital Projects/Expenditures	
TRV Right-of-Way Transaction Costs	$4,273,849

Table 5.11 Charlottesville Metro Area TRV Economic Impacts

Economic Impact of Capital Investment				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	2	$173,673	$272,422	$427,384
Indirect	13	$849,710	$1,471,509	$3,530,759
Induced	8	$428,079	$869,736	$1,431,468
TOTAL	**23**	**$1,451,462**	**$2,613,666**	**$5,389,611**

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	16	$1,869,078	$4,236,159	$9,166,606
Indirect	17	$1,171,567	$1,960,644	$3,521,203
Induced	9	$491,119	$997,561	$1,641,943
TOTAL	**42**	**$3,531,764**	**$7,194,363**	**$14,329,752**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	0	$31,178	$70,664	$152,909
Indirect	1	$45,731	$71,953	$146,167
Induced	0	$18,208	$36,985	$60,876
TOTAL	**1**	**$95,117**	**$179,602**	**$359,952**

Lynchburg MSA

The Lynchburg MSA is characterized by a diverse economy, which includes manufacturing, education, and healthcare. The area is home to several higher education institutions, including Liberty University, Randolph College, University of Lynchburg, Central Virginia Community College, and Sweet Briar College. Liberty University's rapid growth, including the addition of numerous professional programs, has contributed to the city's development. The metro area had an estimated population of 265,474 in 2023 and is projected to grow to 272,830 by 2035, a nearly 3% increase.

The Lynchburg MSA will not benefit from TRV direct capital spending within the region. However, passenger rail enhancements to the New River Valley will slightly expand passenger rail traffic in the region and increase associated operational spending. According to estimates, state-supported routes in 2035 will support approximately 19 direct jobs, $2.2 million in labor income, $5.0 million in value-added, and $10.8 million in output. The total economic impact of state-supported Amtrak operations will be 51 jobs, $3.8 million in labor income, $8.7 million in value-added, and $17.3 million in output. The service extension to the New River Valley will have an economic impact on the Lynchburg MSA of one job, $89,642 in labor income, $243 thousand in value-added, and $437 thousand in output.

Table 5.12 Lynchburg Metro Area Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$62,918
Unemployment Rate, 2023	3.4%
Poverty Rate, 2022	13.0%
Population, 2023	265,474
Population, 2035	272,830
Gross Domestic Production, 2022	$12,464,078,000
Total Employment, 2022	140,360
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington to New River Valley (Route 46 - VA state-supported route)	2
Ridership by Station FY 2023	
Lynchburg	69,487
Estimated O&M Expenditures	
Total	$10,803,753
Additional	$180,218
Capital Projects/Expenditures	
-	-

Table 5.13 Lynchburg Metro Area TRV Economic Impacts

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	19	$2,202,894	$4,992,732	$10,803,753
Indirect	18	$1,015,441	$2,436,930	$4,224,813
Induced	14	$618,599	$1,255,893	$2,233,229
TOTAL	**51**	**$3,836,933**	**$8,685,556**	**$17,261,795**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	0	$36,747	$83,284	$180,218
Indirect	1	$35,123	$124,223	$192,949
Induced	0	$17,772	$36,080	$64,157
TOTAL	**1**	**$89,642**	**$243,587**	**$437,324**

Richmond MSA

The Richmond MSA has an economy centered on finance, government, education, health services, and corporate headquarters. It is the home to eight Fortune 500 headquarters including Performance Food Group, Altria, Carmax, Dominion Energy, Markel, Owens & Minor, Genworth Financial and ARKO. Capital One and Virginia Commonwealth University are also major employers. The MSA had an estimated population of 1,354,620 and is projected to grow by 9% to 1,478,759 by 2035. The city serves as a major hub on several Amtrak routes, including the Amtrak Virginia Northeast Regional service. Its role will be significantly enhanced when the Southeast Corridor to Raleigh is completed as a part of future improvements. As a result of TRV Phase 1 and 2 expansions covered in this study, the region will see the addition of five state-supported daily passenger trains serving the area.

The region will see several major capital projects as a result of the TRV capital improvement program. A Richmond Layover Facility construction project will provide a new facility and tracks for overnight storage and servicing of Amtrak passenger trains. These activities are currently hosted at the Staples Mill Station in Richmond and will be moved to the new Main Street location when the facility is completed with the aim to improve efficiency and support future growth in passenger rail service. The largest project in the region ("Hanover Third Track") will add three miles of third track, reconstruct one roadway bridge, and construct a new rail bridge in Hanover County. TRV will also fund Ettrick Station improvements in Petersburg, Right-of-Way acquisition costs, and design of the S-Line south of Richmond to prepare for future Southeast Corridor improvements that form a key part of the Richmond to Raleigh project to provide passenger rail service from Richmond to Raleigh, North Carolina.

Total TRV capital investment expenditures in the Richmond MSA will be $196.8 million. This spending is estimated to support 956 direct jobs, labor income of $70 million, value-added of $96 million, and output of $167 million. The total impact, including indirect and induced impacts from this spending and spillover spending from other regions is 1,879 jobs, $136 million in labor income, $214 million in value-added, and $369 million in output. The economic impact of all state-supported rail passenger operations spending in FY 2035 is estimated to be responsible for 96 direct jobs, $11.2 million in labor income, $25.5 million in value-added, and $55.4 million in output. The total economic impact is 323 jobs, $28.6 million in labor income, $56.9 million in value-added, and $105.8 million in output. The total economic impact of TRV operations expansion is 57 jobs, $5 million in labor income, $10 million value-added, and $18.7 million in output.

Table 5.14 Richmond Metro Area Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$81,388
Unemployment Rate, 2023	3.0%
Poverty Rate, 2022	10.7%
Population, 2023	1,354,620
Population, 2035	1,478,759
Gross Domestic Production, 2022	$104,993,815,000
Total Employment, 2022	924,600
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington-Richmond (Route 51 - VA state-supported route)	5
Amtrak Virginia Northeast Regional Washington-Norfolk (Route 50 - VA state-supported route)	3
Amtrak Virginia Northeast Regional Washington-Newport News (Route 47 - VA state-supported route)	3
Carolinian (NC state-supported route)	1 train per day/in each direction
Palmetto (long-distance route)	1 train per day/in each direction
Silver Star (long-distance route)	1 train per day/in each direction
Silver Meteor (long-distance route)	1 train per day/in each direction
Ridership by Station FY 2023	
Ashland	33,785
Richmond Staples Mill (RVR)	403,892
Richmond Main St (RVM)	121,315

Economic/Demographic Features	Value
Petersburg	46,274
Estimated O&M Expenditures	
Total	$55,417,989
Additional	$9,882,230
Capital Projects/Expenditures	
Hanover Third Track (Siding C) - Roadwork (R13DR)	$72,000,002
Hanover Third Track (Siding C) - Track Work (R13DT)	$69,967,274
Platform & Station Improvements - SOGR/ADA (R14B)	$10,300,000
Ettrick Station Improvements (R15AB)	$11,750,000
Richmond Layover Facility (RLF)	$3,600,000
S-Line 30% Design (S01A)	$22,990,475
TRV Right-of-Way Transaction Costs (TRVTC)	$6,209,786
TOTAL	**$196,817,537**

Table 5.15 Richmond Metro Area TRV Economic Impacts

Economic Impact of Capital Investment				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	956	$70,368,966	$95,850,752	$167,729,529
Indirect	413	$35,075,875	$59,646,090	$105,422,510
Induced	510	$30,371,582	$58,740,943	$96,235,672
TOTAL	**1,879**	**$135,816,424**	**$214,237,785**	**$369,387,711**

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	96	$11,170,756	$25,518,830	$55,417,989
Indirect	127	$11,514,620	$19,911,905	$31,624,886
Induced	99	$5,909,690	$11,435,211	$18,734,072
TOTAL	**323**	**$28,595,066**	**$56,865,946**	**$105,776,947**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	17	$1,991,988	$4,550,561	$9,882,230
Indirect	22	$2,008,066	$3,476,413	$5,528,730
Induced	17	$1,040,369	$2,013,108	$3,298,034
TOTAL	**57**	**$5,040,424**	**$10,040,082**	**$18,708,993**

Roanoke MSA

The Roanoke MSA is known for its strong healthcare sector, driven by Carilion Clinic's growth and the presence of advanced manufacturing industries. It is also home to a new medical school and research facility, Virginia Tech Carilion. Roanoke has focused most of its economic development efforts on further diversifying its economy, with an emphasis on growing and attracting tech companies and expanding its tourism sector. The metropolitan area had an estimated population of 313,052 in 2023 and is projected to grow by about 3% to 321,480 by 2035. Roanoke's reconnection to the Amtrak network in 2017 is regarded as a significant success, with ridership exceeding expectations and a second train added in 2022.

TRV will result in no direct capital spending within the Roanoke metropolitan area, although future improvements will be made to the Roanoke railyard. It will slightly expand passenger rail traffic and associated operational spending. According to estimates, state-supported route operations in FY 2035 will support approximately 9 direct jobs, $1 million in labor income, $2.4 million in value-added, $5.2 million in output with a total economic impact of 31 jobs, $2.3 million in labor income, $4.9 million in value-added, and $9.9 million in output. The expansion of rail operations to the New River Valley is expected to have an economic impact of two jobs, $123 thousand in labor income, $285 thousand in value-added, and $546 thousand in output

Table 5.16 Roanoke Metro Area Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$64,596
Unemployment Rate, 2023	2.9%
Poverty Rate, 2022	13.1%
Population, 2023	313,052
Population, 2035	321,480
Gross Domestic Production, 2022	$11,079,253,000
Total Employment, 2022	205,209
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington to New River Valley (Route 46 - VA state-supported route)	2
Ridership by Station FY 2023	
Charlottesville	104,515
Estimated O&M Expenditures	
Total	$5,158,421
Additional	$86,048
Capital Projects/Expenditures	
-	-

Table 5.17 Roanoke Metro Area TRV Economic Impacts

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	9	$1,051,806	$2,383,858	$5,158,421
Indirect	13	$851,713	$1,733,992	$3,273,626
Induced	8	$410,583	$829,596	$1,427,243
TOTAL	**31**	**$2,314,103**	**$4,947,447**	**$9,859,290**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	0	$17,545	$39,765	$86,048
Indirect	1	$74,458	$182,373	$351,071
Induced	1	$31,300	$63,242	$108,802
TOTAL	**2**	**$123,303**	**$285,380**	**$545,921**

Virginia Beach-Norfolk-Newport News, VA MSA

The Hampton Roads region, encompassing Virginia Beach, Norfolk, and Newport News, is one of the largest metropolitan areas in Virginia. The economy is heavily influenced by defense, shipbuilding, the port authority, and tourism, with other significant contributions made by healthcare and education. The metropolitan area had an estimated population of 1,836,564 but current projections suggest that it may lose approximately 20,000 residents by 2035 (a decrease of one percent).

TRV will result in no direct capital spending within the Hampton Roads region. Improvements recently completed at the Newport News Transportation Center are not included in the capital expenditures examined in this report. However, the addition of a new weekday/daily train serving Newport News will expand passenger rail traffic and associated operational spending. According to estimates, state-supported route operations in FY 2035 will have a direct economic impact of 32 jobs, $3.7 million in labor income, $8.5 million in value-added, and $18.4 million in output. The total economic impact will be 98 jobs, $7.6 million in labor income, $15.5 million in value-added, and $30.6 million in output. The total economic impact attributable to the new passenger rail service operations in the area is estimated to be 12 jobs, $923 thousand in labor income, $1.9 million in value-added, and $3.7 million in output.

Table 5.18 Virginia Beach-Norfolk-Newport News Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$74,556
Unemployment Rate, 2023	3.1%
Poverty Rate, 2022	11.8%
Population, 2023	1,836,564
Population, 2035	1,817,527
Gross Domestic Production, 2022	$115,912,324,000
Total Employment, 2022	1,120,669
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington-Newport News (Route 47-VA state-supported route)	3
Amtrak Virginia Northeast Regional Washington-Norfolk (Route 50 – VA state-supported route)	3
Ridership by Station FY 2023	
Norfolk	230,114
Newport News	124,877
Williamsburg	69,469
Total	$18,445,873
Additional	$2,184,152
Capital Projects/Expenditures	
-	-

Table 5.19 Virginia Beach-Norfolk-Newport News Metro Area TRV Economic Impacts

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	32	$3,746,450	$8,513,149	$18,445,873
Indirect	39	$2,501,857	$4,280,424	$7,557,695
Induced	27	$1,315,786	$2,714,486	$4,656,248
TOTAL	98	$7,564,093	$15,508,058	$30,659,816

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	4	$443,612	$1,008,031	$2,184,152
Indirect	5	$316,296	$529,753	$937,274
Induced	3	$163,238	$336,762	$577,660
TOTAL	**12**	**$923,147**	**$1,874,546**	**$3,699,086**

Washington-Arlington-Alexandria, VA MSA

The Washington-Arlington-Alexandria MSA, part of the larger Washington, D.C. metropolitan area, is one of the most affluent and highly educated regions in the U.S. With a population of over 6 million, the area is a major economic hub, driven by the federal government, defense contractors, technology firms, and a growing finance sector. The Northern Virginia portion of the metropolitan area has a population of 3,099,054. This is projected to expand by 15% to 3,598,829 in 2035.

The region is a key hub for many of Amtrak's Northeast Corridor services. Its continued growth, coupled with increasing highway congestion, makes rail an increasingly attractive option for both business and leisure travelers. For this reason, most of the TRV Phase 1 and 2 investments are concentrated in this area. The region will receive over $3.8 billion in investments over the next several years. The Long Bridge Project, which entails adding a new two-track railroad bridge, establishing a bicycle and pedestrian bridge across the Potomac River, and making improvements to other rail bridges and infrastructure along a 1.8-mile project corridor, is the largest investment at nearly $2.3 billion (over half of the metropolitan area's total capital investment) and will remove the largest capacity constraint on the I-95 corridor. The improvements will ease congestion along the entire corridor and help accommodate additional passenger and freight rail traffic. Other projects along the corridor will construct additional track and sidings along the most heavily traveled parts of the corridor, replace rail bridges, and add traffic grade separations and other improvements.

TRV capital expenditures of $4.3 billion are expected to support 20,069 direct jobs, nearly $1.7 billion in labor income, approximately $2.3 billion in value-added, and almost $3.8 billion in output. The total impact, including indirect and induced impacts from this spending and spillover spending from other regions, is 29,506 jobs, nearly $2.4 billion in labor income, approximately $3.6 billion in value-added, and over $5.9 billion in output. The economic impact of all state-supported rail passenger operations spending is estimated to support 139 direct jobs, $13 million in labor income, $33.6 million in value-added, and $77.2 million in output. The total impact is 362 jobs, $31.8 million in labor income, $66.6 million in value-added, and $128 million in output. Since much of state-supported rail passenger traffic passes through the region, the operational economic impact of TRV expansion is highest here as well. The total economic impact of TRV operations expansion alone is 81 jobs, $7.1 million in labor income, $14.9 million in value-added, and $28.9 million in output.

Table 5.20 Washington-Arlington-Alexandria Economic/Demographic and Rail Features

Economic/Demographic Features	Value
Median Household Income, 2022	$117,432
Unemployment Rate, 2023	2.5%
Poverty Rate, 2022	7.9%
Population, 2023	3,099,054
Population, 2035	3,598,829
Gross Domestic Production, 2022	$300,687,869,000
Total Employment, 2022	4,631,043
Description of Future Rail Service (# Roundtrips 2035)	
Amtrak Virginia Northeast Regional Washington-New River Valley (Route 46 - VA state-supported route)	2
Amtrak Virginia Northeast Regional Washington-Richmond (Route 51 - VA state-supported route)	5
Amtrak Virginia Northeast Regional Washington-Norfolk (Route 50 - VA state-supported route)	3
Amtrak Virginia Northeast Regional Washington-Newport News (Route 47 - VA state-supported route)	3
Cardinal (long-distance)	3 trains per week/ in each direction
Crescent (long-distance)	1 train per day/ in each direction
Auto Train (long-distance)	1 train per day/ in each direction
Palmetto (long-distance)	1 train per day/ in each direction
Silver Meteor (long-distance)	1 train per day/ in each direction
Silver Star (long-distance)	1 train per day/ in each direction
Carolinian (NC state-supported)	1 train per day/ in each direction

Economic/Demographic Features	Value
Ridership by Station FY 2023	
Alexandria	308,013
Burke Centre	14,230
Culpeper	17,386
Fredericksburg	95,926
Lorton	272,896
Manassas	43,221
Quantico	21,009
Woodbridge	31,837
Estimated O&M Expenditures	
Total	$77,194,102
Additional	$17,444,508
Capital Projects/Expenditures	
Long Bridge North	$1,079,810,739
Long Bridge South	$1,199,279,150
Alexandria Fourth Track	$210,451,761
King and Commonwealth Bridges	$84,037,792
Franconia to Lorton Third Track	$274,999,994
Franconia-Springfield Bypass	$405,000,002
Railroad Bridges over Newington Road	$60,999,992
Neabsco Creek to Woodbridge Third Track (Siding D)	$115,763,024
Aquia Creek Third Track South (Siding E)	$96,629,407
Potomac Creek Road Work (Siding A)	$24,043,344
Potomac Creek Third Track South (Siding A) - Track Work	$157,410,031

Economic/Demographic Features	Value
Crossroads Third Track (Siding F)	$112,327,523
TRV Right-of-Way Transaction Costs	$6,388,904
Franconia to Lorton Third Track (Utilities)	$15,900,000
Potomac Creek Third Track (Utilities)	$1,000,000
Manassas Line Transaction	$357,000,000
Seminary Passage Transaction	$55,300,000
Manassas Line and Seminary Passage Transaction	$6,000,000
Manassas Line – Capital Maintenance	$45,900,000
TOTAL	**4,308,241,663**

Table 5.21 Washington-Arlington-Alexandria Metro Area TRV Economic Impacts

Economic Impact of Capital Investment				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	20,069	$1,689,909,231	$2,259,092,144	$3,783,527,555
Indirect	3,525	$312,847,345	$575,981,488	$975,915,112
Induced	5,912	$370,624,531	$731,216,492	$1,151,278,026
TOTAL	**29,506**	**$2,373,381,108**	**$3,566,290,123**	**$5,910,720,692**

Economic Impact of TRV Operations				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	139	$12,990,409	$33,681,337	$77,194,102
Indirect	146	$13,958,739	$23,369,369	$36,335,072
Induced	77	$4,828,528	$9,538,423	$15,016,522
TOTAL	**362**	**$31,777,676**	**$66,589,128**	**$128,545,695**

Economic Impact of TRV Operations Expansion				
Impact	**Employment**	**Labor Income**	**Value-Added**	**Output**
Direct	31	$2,935,604	$7,611,389	$17,444,508
Indirect	32	$3,089,276	$5,194,441	$8,074,177
Induced	17	$1,071,800	$2,117,291	$3,333,289
TOTAL	**81**	**$7,096,680**	**$14,923,121**	**$28,851,974**

SECTION 6

OTHER ECONOMIC AND SOCIAL IMPACTS

This section describes quantitative and qualitative benefits and economic impacts beyond those covered in the previous section's economic impact analysis of TRV that considered only capital investment and state-supported passenger rail operations. These broader effects include social benefits and economic impacts stemming from the diversion of traffic from automobile travel to passenger rail ridership. The first subsection examines the resulting social benefits. These are assessed using TRV traffic projections for Amtrak state-supported routes using the TRV Phase 2 BCA model (VPRA 2023). It also estimates Wider Economic Benefits that were not included in the BCA model and considers the potential effect of TRV on quality of life and equity. The second section considers some possible dynamic secondary economic impacts of the TRV improvements, including economic impacts that result from the substitution of passenger rail for automobile travel on consumption patterns, business cost savings, and savings from safety improvements.

TRV Social Benefits

TRV computes comprehensive benefits attributable to TRV improvements including not only for state-supported passenger ridership examined in this study, but existing state-supported ridership and existing and future VRE, long-distance Amtrak passenger rail riders, freight, Long-Bridge pedestrian/bicycle, and current and future vehicular traffic. Comprehensive cumulative benefits are estimated at $2.141 billion and discounted (7% discount rate) total benefits at $1.3 billion (VPRA 2023).

This analysis restricts attention to the ridership increase attributable to TRV Phase 1 and 2 improvements. According to Amtrak projections before the pandemic, state-supported routes are projected to see an increase in ridership of 132,300 passengers above trend by 2035 as a result of TRV improvements examined in this study. Total benefits in 2035 are estimated to be $25.7 million, cumulative benefits are $783.6 million, and discounted benefits are $172.2 million. These represent approximately 37% of total cumulative benefits and 14% of discounted benefits.

Benefit categories are divided into passenger productivity, operating costs, crash reduction, and vehicle emissions, external highway use, and transportation diversity and are summarized in **Table 6.1**. The largest benefit category for 2035, the cumulative 2031-2060 period, and present value of benefits is crash reduction, which represents approximately 40% of total benefits. This category represents the value of a decrease in accidents, injuries,

and fatalities resulting from traffic shifting from roads to rail. The second largest category is "external highway use" which represents approximately 25% of total benefits. This category evaluates the value of reducing road congestion, noise, and pavement damage as a result of reduced automobile traffic diverted to passenger rail. Operating costs benefits and passenger productivity benefits (approximately 18% and 15% respectively) are the third and fourth highest values. The former represents user savings in vehicular operation costs for passenger trail travelers that switch to rail while the latter is the imputed value of their time savings. The benefit value of the remaining categories (vehicle emissions and transportation diversity) is an estimated 3% of total benefits.

Table 6.1 Selected User and Non-User Benefits Due to State-Supported Route Traffic supported by Transforming Rail in Virginia

Selected User Benefits	2035	Cumulative 30 years (2031-2060) (2021) dollars)	Present Value (7% Discount Rate)
Passenger productivity	$3,624,490	$119,020,413	$25,731,206
Operating costs	$4,513,835	$135,415,038	$30,467,012
Crash reduction	$10,484,649	$314,539,481	$70,768,198
Vehicle emission*	$436,384	$14,988,340	$6,921,191
External highway use	$6,480,296	$194,408,894	$43,740,033
Transportation diversity	$175,843	$5,275,299	$1,186,889
TOTAL	**$25,715,498**	**$783,647,466**	**$178,814,529**

Source: Weldon Cooper Center Computations using TRV Phase 2 BCA model (4/20/2023)

NOTE: Computations include only benefits attributable to ridership increases on state-operated Amtrak routes due to TRV improvements. It does not include VRE, long-distance, freight, Long-Bridge pedestrian/bicycle, and existing passengers and traffic benefits. Cumulative undiscounted benefits are estimated at $2.141 billion and discounted total benefits at $1.3 billion (VPRA 2023).

According to NAS (2014) guidance, intercity passenger rail has fewer resulting wider economic benefits than other public transit modes, such as urban public transit and commuter rail, which either expand the commuting shed or increase the effective workday population density of major cities including Washington, D.C., Richmond, and the Hampton Roads area. However, DRPT guidelines for Commonwealth Rail Fund (CRF) benefit-cost analysis suggest that Virginia freight and passenger rail projects generate WEBs that are 5%

of user benefits (the low end of the range in the scholarly literature). Using the two-user benefit category totals in Table 6.1 (passenger productivity and operating costs), this benefit would equate to urban productivity benefits of $406,916 in 2035, cumulative benefits of $12.7 million, and a discounted present value of benefits of $2.8 million.

Although not ordinarily accounted for in economic impact analysis of SBCA, the Transforming Rail in Virginia initiative may also improve equity and citizens' quality of life across the state by expanding passenger rail services and improving connectivity. By improving rail service frequency and coverage and expanding access both geographically and to different socioeconomic groups, residents may gain improved access to employment centers, parks and recreation areas, and educational institutions. The initiative supports intercity travel services linked to public transportation that could fill gaps in public transit with fewer or less affordable mobility options such as low-income, minority, and transit-dependent residents. Reduced travel times and congestion may also reduce travel times and stress, resulting in improved quality of life.

Other Economic Impacts

This section considers some potential dynamic secondary economic impacts resulting from TRV improvements. As discussed in Section 4, transportation improvements that result in operating costs savings, productivity enhancements, and savings from improved safety can be quantified in terms of economic inputs that are relevant for economic impact analysis (Weisbrod, Mulley, and Hensher 2016; TREDIS 2023). The numbers used in this analysis were derived from the TRV BCA based on savings that accrue to Virginia state-supported route users as discussed below. Since the economic impacts are more speculative (and may represent "best case" scenarios) and not included in conventional economic impact analysis, they are included here rather than the previous section and referred to as "scenarios." The findings suggest that the economic impacts are not negligible if summed but still constitute a relatively small portion of the capital and operational economic impacts of TRV. For example, the total employment impact of all three aggregated scenarios is 63 jobs, which represents almost one-third of the 198 total employment impact of TRV operations expansion.

Scenario I: Operating Cost Savings Scenarios

The first scenario examines the statewide economic impact of mode switching from automobiles to passenger rail, including the net impact of operating cost savings. This kind of exercise is sometimes performed in more comprehensive analyses of the economic impact of public transit (see Miller, Robison and Lahr 1999). Consumer expenditure savings

are computed by subtracting Amtrak round-ticket price (assumed to average $35 in 2021 for the typical trip) for the number of projected Amtrak passengers (132,300) which equals $4,630,500. This amount is subtracted from expected vehicular operating expenses of $9,027,669 estimated in the TRV Phase 2 BCA model to get $4,397,167. These funds which were formerly spent on automobile operations (e.g., gasoline purchases, vehicular maintenance, and repair) can now be redirected to other consumer spending. This is counted as current vehicular-related costs.[ix]

Table 6.2 shows the economic impact of repurposing this spending from vehicular costs to other consumer expenditures. The analysis shows a positive economic impact of 25 total jobs, $1.9 million in labor income, $3.8 million in value-added, and $7.3 million in output. This net impact results from the fact that automobile operational spending results in large leakages of spending on fuel and other maintenance goods because they are purchased outside the state while the redirected spending is more likely to be produced within the state.

Table 6.2 Economic Impact of Operating Cost Savings

Impact	Employment	Labor Income	Value-Added	Output
Direct	11	$887,165.73	$1,919,193.39	$4,248,415.71
Indirect	8	$699,847.66	$1,201,853.33	$1,949,776.71
Induced	6	$349,910	$694,531	$1,148,108
TOTAL	**25**	**$1,936,923**	**$3,815,577**	**$7,346,301**

Scenario II: Business Cost Savings

The second scenario considers the savings in time that business travelers realize from travelling by rail instead of automobile and the possibility of putting the time to productive use on work activities. The TRV Phase 2 BCA model estimates that half of passengers travel for business purposes on state-supported routes. The hourly productivity rate for trips is assumed to be $32.21 (the annual per capita income for a Richmond City resident divided by the average annual hours worked of 2,080). VMT removed from highways is estimated to be 132,300 (passengers diverted to rail) X 220 miles (distance of an average Amtrak trip/1.48 (average vehicle occupancy) to get 19,625,368. Dividing this VMT by average speed (43.6mph) to get hours saved is then multiplied by the hourly productivity rate ($32.1) for one-half of the VMT to compute the productivity improvement estimate of $7,248,979.

Transportation effects on business productivity can be represented in three different ways depending on industry characteristics such as demand elasticity, market competitiveness, and product/service tradability (TREDIS 2023). Businesses can retain the business cost savings as profits, can pass savings on to customers in terms of reduced prices, or can use the savings for investment. For the purpose of illustration here, it is assumed that the savings are passed on in the form of profits that are realized by proprietors and hence represent an increase in labor income that is used for increased consumer spending.[x]

Table 6.3 shows the economic impact of productivity savings. Since the changes result from an increase in proprietor income, only induced impacts occur. The total economic impact is 30 jobs, $1.7 million in labor income, $3.4 million in value-added, and $5.6 million in output.

Table 6.3 Economic Impact of Business Cost Savings

Impact	Employment	Labor Income	Value-Added	Output
Direct	0	$0.00	$0.00	$0.00
Indirect	0	$0.00	$0.00	$0.00
Induced	30	$1,703,119	$3,368,736	$5,569,083
TOTAL	**30**	**$1,703,119**	**$3,368,736**	**$5,569,083**

Scenario III: Savings from Improved Safety

The third scenario considers savings resulting from a decrease in accidents, injuries, and fatalities as a result of traffic shifting from roads to rail. Savings from averting a loss of income incurred as a result of an injury are re-allocated to households as a positive shock to income.[xi] The loss in human capital (or earnings) averted is estimated using the data from the National Safety Council on the primarily average earnings cost from fatality public injury ($940,000 and work injury without employer cost of $1,370,000) and injury (disabling public injury cost of $6,800 and work injury without employer cost if $33,000).[xii] Based on a 50-50 split of leisure and business travelers, these figures were multiplied by TRV BCA Phase 2 model estimates of .81 fatality averted and 55.8 accidents averted due to vehicular traffic diverted to passenger rail as a result of TRV passenger rail improvements. This equates to $2,043,287 over a lifetime which will be assumed to occur as a positive income shock in the year of crash avoidance in a manner similar to TREDIS (TREDIS 2023c).

Table 6.4 shows the economic impact of safety improvements on avoidance of lost earnings. If these earnings were available to households for consumer spending, the economic impact would be eight jobs, $452 thousand in labor income, $897 thousand in value-added, and nearly $1.5 million in output.

Table 6.4 Economic Impact of Safety Improvements

Impact	Employment	Labor Income	Value-Added	Output
Direct	0	$0.00	$0.00	$0.00
Indirect	0	$0.00	$0.00	$0.00
Induced	8	$451,787	$896,643	$1,482,217
TOTAL	**8**	**$451,787**	**$896,643**	**$1,482,217**

APPENDIX A: CAPITAL INVESTIMENT PROJECT LIST

Project Description	Expenses Incurred to Date	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	Total Project Budget
I-95 Corridor Projects										
Phase 1 Required										
Alexandria Fourth Track	$8.1	$8.0	$36.2	$57.2	$99.4	1.6	-	-	-	**$210.5**
Franconia to Lorton Third Track	$3.2	$14.2	$12.4	$21.8	$122.4	$96.6	4.4	-	-	**$275.0**
Franconia-Springfield Bypass	$3.9	$12.3	$56.2	$121.5	$105.8	80.0	25.3	-	-	**$405.0**
Railroad Bridges over Newington Road	$0.9	$0.9	$3.1	$4.6	$35.5	$16.0	-	-	-	**$61.0**
Potomac Creek Third Track (Siding A) Trackwork	$1.0	$8.4	$15.9	$8.9	$68.7	$45.6	$8.9	-	-	**$157.4**
Potomac Creek Third Track (Siding A) Roadwork	-	$0.2	$1.4	$2.1	$6.1	10.4	3.8	-	-	**$24.0**
Woodford to Milford Third Track (Siding B)	$0.1	$3.6	$8.7	$10.4	$36.6	$10.9	-	-	-	**$70.3**
Hanover Third Track (Siding C) Trackwork	$0.1	$2.1	$9.9	$8.6	$26.1	$22.1	$1.1	-	-	**$70.0**
Hanover Third Track (Siding C) Roadwork	-	$1.1	$8.5	$46.5	$15.9	-	-	-	-	**$72.0**
King and Commonwealth Bridges	$0.5	$2.6	$24.5	$37.4	$19.1	-	-	-	-	**$84.1**
Richmond Layover Facility	$0.6	$1.2	$1.8	-	-	-	-	-	-	**$3.6**

Project Description	Expenses Incurred to Date	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	Total Project Budget
Phase 2 Required										
Long Bridge - North	$16.3	$37.1	$117.2	$141.2	$156.9	$168.6	$219.5	$182.8	$40.2	**$1,079.8**
Long Bridge - South	$16.3	$8.8	$55.3	$170.2	$308.5	$238.1	$232.5	$114.5	$55.0	**$1,199.2**
Neabsco Creek to Woodbridge Third Track (Siding D)	$0.1	$0.1	$6.0	$6.4	$2.8	$32.9	$33.6	$33.9	-	**$115.8**
Aquia Creek Third Track (Siding E)	$0.1	$0.2	$3.9	$5.3	$2.8	$28.1	$28.1	$28.1	-	**$96.6**
Crossroads Third Track (Siding F)	$0.1	$0.1	$5.6	$6.4	$2.1	$32.4	$32.8	$32.9	-	**$112.4**
Other										
TRV Right-of-Way Transaction Costs	$19.6	$7.8	$7.4	-	-	-	-	-	-	**$34.8**
Utility Relocation Projects										
Franconia to Lorton Third Track: Fairfax	-	-	5.4	10.5	-	-	-	-	-	**15.9**
Potomac Creek Third Track: Stafford	-	-	1.0	-	-	-	-	-	-	**1.0**
Total I-95 Corridor Projects	**$70.9**	**$108.7**	**$380.4**	**$659.0**	**$1,008.7**	**$783.3**	**$590.0**	**$392.2**	**$95.2**	**$4,088.4**
Western Corridor Projects										
New River Valley Passenger Rail Project	$2.1	$6.0	-	-	-	-	-	-	-	**$8.1**
Capital Improvements - Bridges	$0.5	$1.0	-	-	-	-	-	-	-	**$1.5**
Capital Improvements - Other	$2.3	$9.3	-	-	-	-	-	-	-	**$11.6**

Project Description	Expenses Incurred to Date	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	Total Project Budget
Cambria Platform & Radford Layover	$0.0	$0.0	$13.1	$42.5	$9.8	-	-	-	-	**$65.4**
Total Western Rail Corridor Projects	**$4.9**	**$16.3**	**$13.1**	**$42.5**	**$9.8**	**$0.0**	**$0.0**	**$0.0**	**-**	**$86.6**
Other Capital Projects										
Ettrick Station Improvements - SOGR	$0.2	$1.1	$2.5	$8.0	-	-	-	-	-	**$11.8**
S-Line 30% Design	0.3	2.2	18.5	13.5	5.0	-	-	-	-	**$39.5**
Platform & Station Improvements - SOGR/ADA	0.1	5.7	5.8	4.0	2.5	2.5	-	-	-	**$20.6**
Manassas Line - Transaction	-	-	315.0	-	42.0	-	-	-	-	**$357.0**
Seminary Passage - Transaction	-	-	55.3	-	-	-	-	-	-	**$55.3**
Manassas Line & Seminary Passage Transaction Costs	-	-	6.0	-	-	-	-	-	-	**$6.0**
Manassas Line - Capital Maintenance	-	-	3.0	3.9	4.1	4.3	4.4	4.6	4.7	**$29.0**
Total Other Capital Projects	**$0.6**	**$9.0**	**$406.1**	**$29.4**	**$53.6**	**$6.8**	4.4	4.6	4.7	**$519.2**
Total All Capital Projects	**$76.4**	**$134.0**	**$799.6**	**$730.9**	**$1,072.1**	**$790.1**	**$594.4**	**$396.8**	**$99.9**	**$4,694.2**

Source: Virginia Passenger Rail Authority (2024)

APPENDIX B: IMPLAN DATA INPUTS

Data used for the economic impact analysis were obtained from the VPRA, who provided both operational and capital investment data. Operational expenditures include the ongoing expenditures needed to operate and maintain passenger rail for state-supported routes.[xiii] Capital spending consists of spending for planning, engineering, and construction of TRV projects described in the first section, consisting largely of Phase 1 and 2 of the I-95 projects and New River Valley projects.

Operational data included projected revenues and expenditures for each state-supported route in Virginia through 2045, including Route 46 (Washington, D.C. to Roanoke and ultimately to the New River Valley), Route 47 (Washington, D.C. to Newport News), Route 50 (Washington, D.C. to Norfolk), and Route 51 (Washington, D.C. to Richmond). Two scenarios were modelled: a TRV operations analysis that considers the economic impact of all state-supported Amtrak activity and an economic impact analysis that examines only the additional activity that results from increasing ridership, expenditures, and revenues for the additional passenger trains resulting from TRV service improvements by FY 2035. VPRA operational expenditures were escalated by an inflationary factor throughout the FY 2024-2045 period and new service levels were indicated by periodic bumps in operational spending for each route when a new service was introduced. There was no similar jump in expenditures for Route 51 that terminates in Norfolk because there are no associated train service improvements for that route over the period. In order to determine the additionality or impact of TRV service expansion on operations, baseline expenditures reflecting only inflationary escalation growth were subtracted from total expenditures over the period to determine the residual growth due to service expansion.

In order to assign spending to regions, Amtrak expenditures by each route were apportioned to each locality (county/independent city) based on the passenger rail mileage that traversed the locality.[xiv] Since the New River Valley service is new, its footprint and additionality spending is the same. The remaining geographies' residual spending were apportioned with that control total. The individual counties were then cross walked with metro regions using the July 2023 Office of Management and Budget MSA definitions

A detailed accounting of expenditure by item was not available. Therefore, the operations were modelled by using IMPLAN sector 415 (Rail transportation). This sector includes both freight and railroad activity as well as passenger railways. Several validity checks were done with the sector, including that it was able to replicate the approximate average payroll wages and direct Amtrak employment headcount in the base year. Second, the regional results

were compared to other recent studies of TRV improvements such as a VCU study (MacKenzie 2022) of TRV passenger rail improvements for the Richmond region.

Geographical assignment of capital investment was generally more straightforward. Most capital improvements occurred in a single locality. For example, the Hanover Third Track project occurs in Hanover County and Richmond Layover Facility in the City of Richmond. However, there were two projects (S Line Design and TRV Right-of-Way Transaction Costs) where the projects are associated with an entire corridor. These capital costs were apportioned to localities based on the passenger rail mileage that traversed the locality. The New River Valley Passenger Rail Project was also treated differently because the project is still in the development stage and detailed project cost estimates by geography are not available. This spending was assigned entirely to the Blacksburg-Christiansburg MSA. Lastly, two capital investment projects that will be funded by VPRA TRV during the period were not considered in the analysis. These were the L'Enfant Fourth Track and Station Improvements TRV project, which was excluded because construction occurs in Washington, D.C. The Arkendale to Powell's Creek Third Track project is excluded because it is now considered outside the scope of TRV.

Capital expenditure data provided by VRPA for FY 2023- FY 2035 was divided into six categories: project development, right-of-way acquisition, engineering, construction, unallocated contingency, and project management and administration. The capital expenditure represents budgeted funds and not project expenditure timing. Therefore, the expenditures were summed up for the period (the last year with project expenditure data was FY 2031). The following assignments by budget category were made:

- Project management and administration were assigned to IMPLAN Sector 362 (Management consulting services—equivalent to NAICS 6-digit sectors 541611-13, 18) since this consists largely of outsourced private project management services spending.
- Project development and engineering spending were assigned to IMPLAN sector 457 (Architectural, engineering, and related services).
- Construction and unallocated contingency were assigned to IMPLAN Sector 54 (Construction of new highways and streets) which most closely aligned with the project types and input purchase pattern expected of rail construction.
- Since acquisitions of existing property are treated as transfers and do not generate economic impacts, they are not included in economic impact analysis. However, right-of-way acquisition also entails certain transaction costs such as surveying, environmental analysis, and legal assistance. Based on similar public sector land

acquisitions, it was assumed that 5% of the right-of-way acquisition costs were legal services expenses (IMPLAN Sector 455 or Legal services) and 5% were environmental/surveying related (IMPLAN Sector 457 or Architectural, engineering, and related services).

GLOSSARY OF TERMS

Agglomeration Economies: The benefits that firms and individuals gain by locating near each other. These benefits include reduced transportation costs, access to a larger labor pool, and enhanced opportunities for knowledge sharing and innovation.

Amtrak: A passenger railroad service that provides medium- and long- distance intercity service in the contiguous United States.

Benefit-Cost Analysis (BCA): A method that evaluates the overall value of a project by comparing its benefits and costs, including non-market effects like travel time savings and environmental benefits.

Blacksburg-Christiansburg MSA: A metropolitan statistical area in Virginia that includes Floyd County, Giles County, Montgomery County, Pulaski County, and Radford City.

Capital Investment: Funds used by an organization to acquire, upgrade, and maintain physical assets such as property, industrial buildings, or equipment.

Charlottesville MSA: A metropolitan statistical area in Virginia that includes Albemarle County, Fluvanna County, Greene County, Nelson County, and Charlottesville City.

Commonwealth Rail Fund (CRF): A fund created to support rail investments in Virginia, sourced from state transportation revenues.

Commuter Rail: A type of passenger rail service that primarily operates between a city center and its suburbs or other locations that draw large numbers of people daily, typically during peak commuting hours. Within Northern Virginia, this service is provided by Virginia Railway Express (VRE).

Direct Effect: The immediate economic impact of spending in a region, such as jobs created directly by a project.

Economic Impact Analysis: A method to evaluate the effects of a project on a region's economy, including employment, output, and income.

Employment: The total number of jobs, including full-time, part-time, and self-employed positions, within a specific region or industry.

Government Revenue: The income that the government collects from taxes, including income tax, sales tax, property tax, and other forms of revenue (e.g., licenses, fees).

High-Speed Rail (HSR): A type of passenger rail transport that operates significantly faster than traditional rail traffic, typically at speeds of 125-250+ mph. HSR is designed to provide fast, efficient, and reliable transportation over long distances, often connecting major cities and regions.

Indirect Effect: The economic impact resulting from the purchases of goods and services by businesses directly affected by a project.

Induced Effect: The economic impact resulting from increased household spending due to higher incomes from direct and indirect effects.

Input-Output Model: A quantitative economic technique that represents the interdependencies between different branches of a national economy or different regional economies.

Intercity Passenger Rail: Rail services that connect cities over medium to long distances, typically operated by Amtrak in the U.S.

IMPLAN: An economic impact modeling system used to estimate the effects of economic changes in a region.

Labor Income: This refers to the total earnings of employees (employee compensation) and business owners (proprietor income) in the form of wages, salaries, and benefits.

Light Rail: A type of urban rail transit that typically operates at a lower capacity and speed than heavy rail or commuter rail, often on tracks that are shared with other vehicles.

Lynchburg MSA: A metropolitan statistical area in Virginia that includes Amherst County, Appomattox County, Bedford County, Campbell County, Bedford City, and Lynchburg City.

Long Bridge Project: A major infrastructure project to expand a key rail bridge over the Potomac River, alleviating a significant bottleneck for both passenger and freight trains.

Metropolitan Statistical Area (MSA): A geographical region with a relatively high population density at its core and close economic ties throughout the area.

Multiplier: In economic impact analysis, a multiplier measures the ripple effect of an initial spending or investment on the broader economy. It captures the direct, indirect, and induced impacts of spending.

NAICS (North American Industry Classification System): A system used by business and government to classify and measure economic activity in Canada, Mexico, and the United States.

Operational Expenditures: The ongoing costs required for the day-to-day functioning of a project or service. In the context of rail services, this includes costs related to maintenance, employee wages, fuel, and other recurring expenses necessary to keep the rail services operational.

Output: The total value of goods and services produced by an industry or sector within a specific period.

Passenger Rail: Rail services that transport passengers rather than freight.

Richmond MSA: A metropolitan statistical area in Virginia that includes Amelia County, Charles City County, Chesterfield County, Dinwiddie County, Goochland County, Hanover County, Henrico County, King and Queen County, King William County, New Kent County, Powhatan County, Prince George County, Sussex County, Colonial Heights City, Hopewell City, Petersburg City, and Richmond City.

Right-of-Way (ROW) Acquisition: The process of obtaining land for transportation projects, such as railways, highways, or pipelines.

Roanoke MSA: A metropolitan statistical area in Virginia that includes Botetourt County, Craig County, Franklin County, Roanoke County, Roanoke City, and Salem City.

Social Cost-Benefit Analysis (SCBA): An analysis that evaluates the broader societal effects of a project, including non-market impacts like environmental benefits and quality of life improvements.

Transforming Rail in Virginia (TRV): An initiative led by the Virginia Passenger Rail Authority to expand and improve passenger rail services in Virginia.

Value-Added: The net output of a sector after adding up all outputs and subtracting intermediate inputs. It represents the contribution of labor and capital to the production process.

Virginia Beach-Norfolk-Newport News MSA: A metropolitan statistical area that includes in its Virginia portion: Gloucester County, Isle of Wight County, James City County, Mathews County, Surry County, York County, Chesapeake City, Hampton City, Newport News City, Norfolk City, Poquoson City, Portsmouth City, Suffolk City, Virginia Beach City, and Williamsburg City.

Virginia Department of Rail and Public Transportation (VDRPT): A state agency responsible for overseeing and promoting rail and public transportation services in Virginia.

Virginia Passenger Rail Authority (VPRA): A state political subdivision responsible for overseeing and expanding passenger rail services in Virginia.

Virginia Railway Express (VRE): A commuter rail service that operates in Northern Virginia and Washington, D.C.

Washington-Arlington-Alexandria MSA: A metropolitan statistical area that includes as its Virginia portion: Arlington County, Clarke County, Fairfax County, Fauquier County, Loudoun County, Prince William County, Rappahannock County, Spotsylvania County, Stafford County, Warren County, Alexandria City, Fairfax City, Falls Church City, Fredericksburg City, Manassas City, and Manassas Park City.

Wider Economic Benefits (WEBs): Positive economic impacts that go beyond the direct user benefits of a transportation project, such as increased economic activity due to improved connectivity.

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ENDNOTES

[i] This description does not include a corridor running from Doswell to Charlottesville to Staunton that terminates in Clifton Forge that is served by Amtrak's long-distance Cardinal route. There are no major improvements currently planned here as part of the TRV initiative.

[ii] https://www.reuters.com/business/autos-transportation/us-railroad-amtrak-track-break-passenger-records-2024-2024-06-12/

[iii] Amtrak's Acela service currently reaches 150 mph and will attain top speeds of 160mph when new trains enter service.

[iv] Soft barriers cited include: (1) inaccurate perceptions, (2) conscious car dependence, (3) convenience and freedom, (4) lack of control (over journey characteristics), (5) journey planning requirements, (6) information provision, (7) station facilities (lack of or substandard), (8) cleanliness and maintenance, (9) personal security, (10) staff presence, (11) comfort, (12) crowding, (13) other passengers, and (14) image of public transport.

[v] Complementary barriers cited include: (1) trip chaining, (2) habit (past mode choices are a strong predictor of current mode choice), (3) individuality, (4) age/health/disability, (5) ethnicity/faith/culture, (6) goods and baggage (need to transport large quantities of luggage), (7) locational preferences (people choose residential environment that suits their travel preference), (8) influence of employers (work-related care requirements, working hours not corresponding to public transport availability), (9) sub-optimal prices (car dependent land is underpriced—doesn't cover environmental costs), and (10) weather.

[vi] Revealed preference methods are economic valuation methods that recognize that non-market benefits can be estimated based on trade-offs that people make between the benefit and some other priced market good. For instance, in transportation analysis, revealed preference might estimate how much value people place on reducing injuries by examining how much they pay for automobiles with additional safety features. Stated preference methods solicit information from individuals on how eager they would be to pay in order to realize the benefit such as reduced risk of injury (or correspondingly, how much they would be willing to accept increased risk of the injury).

[vii] Local government revenue estimates are obtained from IMPLAN for subcounty general (e.g., township government), subcounty special districts and county. The methodology that IMPLAN uses to estimate local government revenue using IMPLAN economic impact results

can be found at: https://support.implan.com/hc/en-us/articles/115009674528-Generation-and-Interpretation-of-IMPLAN-s-Tax-Impact-Report

[viii] A distinction can also be made and computations developed to distinguish between localization and urbanization economies (Graham and Gibbons 2019). Localization economies arise when firms in the same industry cluster in a particular geographical area because of benefits from specialized labor pools, shared inputs, and knowledge spillovers while urbanization economies arise form the scale, density, and diversity of a region which benefits firms in a variety of industries in the area.

[ix] This scenario was modelled in IMPLAN by subtracting the economic impact of automobile travel from that of passenger train travel. For calculating the economic impact of train travel, $4,630,500 representing train fares was assigned to IMPLAN sector 415 (Rail transportation) and the retail margin for the expenditure of $4,397,169 was assigned to IMPLAN sector 411 (Retail-General merchandise stores). For calculating the economic impact of automobile travel, total vehicular operating costs of $9,027,669 were divided into fuel (65%) and maintenance (35%) based on AAA estimates of driving costs for 2022. The IMPLAN assignments were retail margins for expenditures of -$5,867,985 assigned to IMPLAN sector 408 (Retail Gasoline Stores), retail margins for -$1,579,842 in expenditures to IMPLAN sector 402 (Retail-Motor vehicle and parts dealers) and -$1,579,842 to IMPLAN sector 512 (Auto repair and maintenance).

[x] This is represented in IMPLAN as an increase in labor income (which included proprietor's income).

[xi] This is represented in IMPLAN as an increase in labor income.

[xii] National Safety Council. Injury Facts: Guide to Calculating Costs. https://injuryfacts.nsc.org/all-injuries/costs/guide-to-calculating-costs/data-details/

[xiii] The analysis does not include any operational expenditures associated with VRE future ridership for two reasons. First, VRE ridership is not likely to recover to pre-COVID-19 pandemic thresholds within the timeframe of this analysis. Thus, any improvements are difficult to link to the TRV capital improvements unlike the Amtrak state-supported route ridership figures. Second, the VRE is currently engaged in a System Plan Update and the financial and ridership figures available in the report have had not been publicly released

while this analysis was conducted. The last VRE System Plan 2040 was released in 2014 (well before the pandemic) and the financial and ridership projections are no longer relevant.

[xiv] This method was also used in the MacKenzie (2022) and Chapman and Fuller (2019) economic impact studies for TRV. An alternative method of apportioning operational and maintenance expenditures is provided by Sperry, Taylor and Roach (2013) which assigns procurement and employee wage expenditures to individual rail stations if they had a relationship to a particular station.