CAMBRIDGE SYSTEMATICS

Economic Impacts of Public Transportation in the Commonwealth of Virginia

Technical Report

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Prepared for

Commonwealth of Virginia,

Department of Rail and Public Transportation (DRPT)

Prepared by

Cambridge Systematics, Inc.

February 2020

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Cambridge Systematics, Inc.
3 Bethesda Metro Center
Suite 1200
Bethesda, MD 20814

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1.0 Introduction

The Virginia Department of Rail and Public Transportation (DRPT) plays a critical role in allocating millions of dollars in state and federal funding each year to support the operation expenses, capital purchases, and planning activities of transit services throughout the state. Increasingly, transit agencies have used economic analysis, return-on-investment (ROI) calculations, and qualitative stakeholder stories to "make the case" for continued and increased transit funding. In this economic impacts study, DRPT builds on prior studies within Virginia and economic studies conducted around the country to develop a comprehensive picture of the total value that transit services bring to the Virginia economy. This study also communicates these benefits in a manner that tells a compelling story about the multiple ways in which transit services and operations add value to the state.

The study had two key objectives:

- To quantify how existing transit services generate economic value to the state; and
- To enable DRPT to communicate the expected benefits that would come from continued investment to improve and expand transit throughout the state.

The study utilized data on system performance, capital investments, and operating expenses for all 41 agencies operating transit services in the state, including the VRE commuter rail and the Virginia portion of WMATA Metrorail system. The direct benefits of transit investments were estimated across a range of measures illustrating the comprehensive affects that the transit industry has on the state's economy. The economic impact of the direct benefits attributed to transit were estimated in terms of employment opportunities created, personal income earned, Gross State Product (GSP) generated, and tax revenue collected.

Beyond these monetized economic impacts, the study also reviewed a range of additional qualitative benefits attributed to the presence of transit, including positive effects on property values, public health, access to social services, the built environment, and economic development opportunities.

This technical report is organized as follows:

- **Section 1** provides an introduction to the study, an overview of its objectives, and a summary of transit services and ridership throughout the state.
- **Section 2** documents recent findings regarding the economic benefits of transit published in research completed by agencies in Virginia and throughout the country.
- **Section 3** documents the analytical framework that was used to estimate the direct, indirect, and induced wider economic impacts of transit services throughout the state. This section also includes a discussion of the geographic resolution of the analysis, key considerations related to the transit modes available in Virginia, potential benefits and metrics, data sources, and assumptions that were made to assess the quantifiable benefits.
- **Sections 4** thru **9** document the quantifiable direct economic benefits attributed to transit services in Virginia today. These sections describe the methods and tools used to monetize

these benefits, explain how the expected direct economic impacts are translated into inputs for an economic model, and document the findings of the economic analysis.

- **Section 10** assesses the qualitative benefits attributed to transit in Virginia that are difficult to quantify in monetary terms, but that none-the-less need to be considered when decisions are made surrounding transit investments in the state.

- **Section 11** summarizes the direct economic benefits and total economic impact of transit in Virginia today. An estimation of the benefit/cost ratio (BCR), the Return on Investment (ROI), and the implicit jobs multiplier from transit services in Virginia is also presented in this section.

1.1 Overview of Transit Services in Virginia

Jurisdictions throughout Virginia operate a variety of transit modes, including fixed-route and demand-response bus services, paratransit, bus rapid transit (BRT), commuter bus service, , ferries, heavy rail, commuter rail, and light rail. **Table 1-1** lists the agencies that operate transit services in Virginia and jurisdictions they serve. All transit agencies, except the Washington Metropolitan Area Transit Authority (WMATA), are based in Virginia.

Transit agencies across the state provided 173.4 million unlinked passenger trips in FY2018 (**Table 1-2**). Out of 41 total transit agencies, WMATA's rail, bus, and paratransit transit services carried 63 percent of the state's transit trips while 40 other transit agencies based throughout Virginia provided the remaining 37 percent of trips. Seventeen (17) of these 41 transit agencies in Virginia operate paratransit services in addition to other services. Hampton Roads Transit (HRT) is the only agency in the state that operates light rail service (The Tide – Norfolk, VA) and a ferryboat system. Virginia Railway Express (VRE) operates the only commuter rail system in the state and leases track from Norfolk Southern as well as CSX railroads. WMATA provides heavy rail service in Northern Virginia with their DC Metrorail system. WMATA Metrorail service alone accounted for 53 percent of the total ridership in FY2018.

Table 1-1 Transit Service Areas in Virginia

	Transit Agency	Service Areas
1	Alexandria Transit Company*	Alexandria
2	Altavista Community Transit System (ACTS)	Altavista
3	Arlington County Transit (ART)*	Arlington
4	Bay Transit	Charles City, Essex, Gloucester, King and Queen, King William, Lancaster, Mathews, Middlesex, New Kent, Northumberland, Richmond County, and Westmoreland
5	Blacksburg Transit*	Blacksburg
6	Blackstone Area Bus System (BABS)	Amelia, Blackstone, Brunswick, Buckingham, Cumberland, Lunenburg, Nottoway, and Prince Edward
7	Bristol Virginia Transit*	Bristol
8	Central Shenandoah Planning District Commission (BRITE)	Augusta, Staunton, and Waynesboro
9	Charlottesville Area Transit (CAT)*	Albemarle, Charlottesville
10	Chincoteague Pony Express	Chincoteague
11	City of Fairfax (CUE)	Fairfax City

	Transit Agency	Service Areas
12	Danville Transit*	Danville
13	District Three Public Transit (Mountain Lynx)	Abingdon, Bland, Carroll, Galax, Grayson, Marion, Smyth, Wythe, Wytheville, and Washington
14	Fairfax County (Fairfax Connector)	Fairfax County
15	Farmville Area Bus (FAB)*	Farmville
16	Four County Transit	Buchanan, Dickenson, Russell, and Tazewell
17	Fredericksburg Regional Transit (FRED)	Caroline, Fredericksburg, Spotsylvania, and Stafford
18	Graham Transit	Bluefield
19	Greater Lynchburg Transit Company (GLTC)*	Amherst and Lynchburg
20	Greater Richmond Transit Company (GRTC)*	Chesterfield, Henrico, and Richmond
21	Greater Roanoke Transit Company (Valley Metro) *	Roanoke
22	Greene County Transit	Greene County
23	Greensville-Emporia Transit	Greensville and Emporia
24	Hampton Roads Transit (HRT)*	Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach
25	Harrisonburg Department of Public Transportation (HDPT)*	Harrisonburg
26	JAUNT	Albemarle, Buckingham, Charlottesville, Fluvanna, Louisa, and Nelson
27	Lake Country Area Agency on Aging	Brunswick, Halifax, and Mecklenburg
28	Loudoun County (LC Transit)	Loudoun County
29	Mountain Empire Older Citizens (MEOC)	Lee, Norton, Scott, and Wise
30	Petersburg Area Transit (PAT)*	Petersburg
31	Potomac and Rappahannock Transportation Commission (PRTC) (OmniRide, OmniLink)	Manassas, Manassas Park, and Prince William
32	Pulaski Area Transit (PAT)	Pulaski
33	RADAR	Alleghany, Clifton Forge, Covington, Henry, Lexington, Martinsville, Roanoke, and Rockbridge
34	Radford Transit	Radford
35	STAR Transit	Accomack and Northampton
36	Suffolk Transit*	Suffolk
37	Virginia Railway Express (VRE)	Alexandria, Fairfax, Fredericksburg, Manassas, Manassas Park, Prince William, Spotsylvania, and Stafford
38	Virginia Regional Transit (VRT)	Culpeper, Fauquier, Loudoun, Orange, and Warren
39	Winchester (WinTran)*	Winchester
40	Williamsburg Area Transit (WATA)*	James City, Williamsburg, and York
41	Washington Metropolitan Area Transit Authority (WMATA)*	Alexandria, Arlington, Fairfax County, Fairfax City, Falls Church, and Loudoun

Notes:

1. Sources: Report of the Secretary of Transportation "How the Commonwealth is Using Transit and Transportation Demand Management to Reduce Congestion and Use of Single-Occupant Vehicles" to the General Assembly of Virginia (Commonwealth of Virginia, Richmond, 2018), and DRPT.
2. *These transit agencies also offer paratransit services.

Table 1-2 Transit Ridership FY2018

Transit Mode	Ridership FY2018	Ridership FY2018 (%)	Data Source
Bus (Non-WMATA), Paratransit (Non-WMATA), Ferry (HRT), Light Rail (HRT)	60,034,656	34.5%	DRPT 2015-2018 Performance Data
VRE Commuter Rail	4,631,909	2.7%	
Sub-Total	**64,666,565**	**37.2%**	
WMATA Metrorail (VA Only)	91,116,096	52.6%	Report of the Secretary of Transportation "How the Commonwealth is Using Transit and Transportation Demand Management to Reduce Congestion and Use of Single-Occupant Vehicles" to the General Assembly of Virginia (Commonwealth of Virginia, Richmond, 2018)
WMATA Metrobus (VA Only)	17,293,559	10.0%	
WMATA Paratransit (VA Only)	339,196	0.2%	
Sub-Total	**108,748,851**	**62.8%**	
Total	**173,415,416**	**100.0%**	

Note:

1. The statewide ridership reported in this table does not include vanpool transportation or the special transportation services for seniors and individuals with disabilities funded by the FTA Section 5310 program that are provided by human service providers.

1.2 Report Objectives

This report documents the methodology used to estimate the wider economic impacts generated today by transit operations and services in Virginia as well as expected economic benefits to come from further investments in transit in the future. Documentation includes information on:

- the analytical framework used to estimate the wider economic impacts arising from transit services and investments today;
- the quantifiable and non-quantifiable benefits arising from transit services and investments;
- the approach used to monetize the quantifiable expected direct economic impacts; and
- the resulting wider economic impacts of those quantifiable with expected direct economic impacts in Virginia.

2.0 Literature Review and Initial Stakeholder Interviews

This literature review summarizes research and studies concerned with the economic benefits of transit completed by transportation agencies in Virginia and around the country, the American Public Transportation Association (APTA), the Transit Cooperative Research Program (TCRP), universities, and research centers. This section also documents the initial outreach effort that solicited insights from DRPT stakeholders into the state's transit challenges today as well as the desired outcomes from this study.

The methodology for completing this Economic Impacts of Transit study, outlined in Section 3, was developed in part based on the research reviewed herein.

2.1 Prior Studies on the Economic Benefits of Transit in Virginia

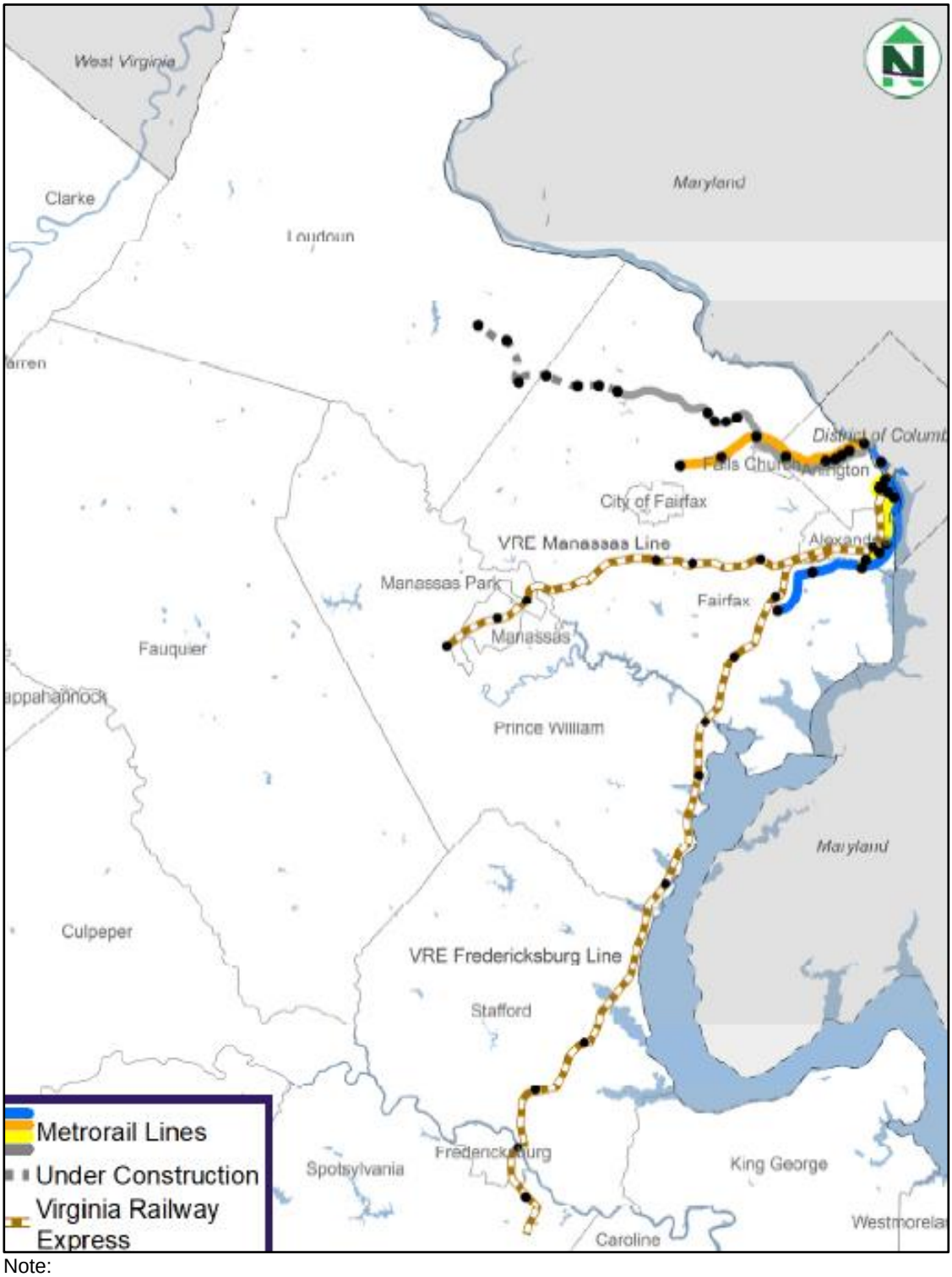
This section reviewed relevant studies on the economic importance of transit in the Commonwealth of Virginia. The review includes the study objectives; data and sources used; the methodology and tools utilized to assess the direct and total wider economic impacts; and key analysis findings.

The Value of Metrorail and the Virginia Railway Express (VRE) to the Commonwealth of Virginia.

"*The Value of Metrorail and the Virginia Railway Express to the Commonwealth of Virginia"* was prepared by the Northern Virginia Transportation Commission (NVTC) and published in July of 2018. The aim of the study was twofold: 1. to quantify how the Washington Metropolitan Area Transit Authority's (WMATA) Metrorail system and VRE commuter rail system financially benefit Virginia, and 2. to estimate the value and worth of land development, as well as state sales tax revenue generated by WMATA (Metrorail) and VRE networks.

To quantify the value that Metrorail and VRE bring to the Virginia economy, the study developed and compared three conditions for the analysis. The first condition summarized the current traffic and existing development in the state. The second condition removed Metrorail and VRE from Northern Virginia, and the third condition shifted development out of Northern Virginia to the District of Columbia or Maryland until traffic demand models showed a return to current levels of peak-period congestion. The analysis estimated the level of multimodal activity the state transportation network can support and evaluated the interaction between land use and transportation demand.

Figure 2-1 Metrorail and VRE Service in Northern Virginia



Note:

1. Source: *The Value of Metrorail and the Virginia Railway Express to the Commonwealth of Virginia.* Prepared for: Virginia Railway Express (VRE) and Washington Metropolitan Area Transit Authority/Metrorail (WMATA/METRO). Prepared by: Northern Virginia Transportation Commission (July 2018).

Key data sources and tools use in this analysis included:

- Metropolitan Washington Council of Governments (MWCOG) 2007/2008 Household Travel Survey
- Income tax information from the 2010 US Census and the Internal Revenue Service (IRS)
- 2009 American Community Survey (ACS) from the U.S. Census
- WMATA passenger survey data
- VRE and WMATA transit ridership data
- State highway traffic counts
- Existing mode share data
- National Transit Database (NTD) transit provider statistics
- Commonwealth Data Point that explains how dollars are spent in state's general fund
- MWCOG/TPB travel demand forecast model
- Cooperative forecast data which include population, households, housing units, and employment information that each local jurisdiction submits to MWCOG and is then fed into the MWCOG/TPB travel demand forecast model)
- Data describing transportation networks (physical features + operating policies) use as travel demand forecast model inputs to calculate travel times between origin and destination (OD) pairs.

This analysis used the MWCOG/TPB travel demand forecast model to determine the impact of the transit network and land use changes under the three conditions outline above. The travel demand model forecast was used to estimate trip generation (how much travel occurs and why?), trip distribution (where does travel occur?), mode choice (what modes, e.g., automobile, transit, will be used?) and trip assignment (which path or route is used?).

The study concluded that the economic benefits that transit brings to Northern Virginia include the following:

- WMATA and VRE move large numbers of people, relieve congestion, and are integral components of local land use as well as economic development plans. For instance, VRE provided nearly 20,000 trips per weekday, and more than 60 percent of VRE riders come from Stafford, Fairfax, Prince William and Spotsylvania counties.
- Rail transit has attracted jobs and households to Northern Virginia. Those residing in Northern Virginia often choose to live in areas with dense transit-oriented development (TOD) that collocate apartments, shops, and businesses close to Metrorail stations. Many people that live in these areas use Metrorail to travel instead of driving.

The wider economic impacts that would result from a lack of rail transit services in Northern Virginia include the following:

- Commuters would suffer from increased congestion without rail transit –
    - Average commute distances would drop by 5 percent over the same travel time.
    - There would be an additional 56,500 lane miles of congestion on arterial roadways because transit riders would have to shift toward alternative motorized transportation modes (mainly buses and auto).
- Transit mode share would be reduced from 18 percent to 8 percent (**Table 2-1**)
- There would be 50 percent less transit trips during peak periods because transit riders would have to forgo their trips.

- There would be 130,000 less transit trips per weekday because transit riders would have to forgo their trips.
- Northern Virginia households would see an 80 percent reduction in the number of jobs they would be able to reach by transit if VRE and Metrorail did not exist.

Table 2-1 Commuters Riding Transit: Existing and Existing without Rail Modes

Jurisdiction	Existing (%)	Existing without WMATA Metrorail and VRE Commuter Rail (%)
Arlington	49%	28%
Alexandria	38%	24%
Fairfax	17%	6%
Loudoun	4%	2%
Prince William	5%	3%
Northern Virginia Total	18%	8%

Note:

1. Source: Transportation Planning Board V2.3.66 Travel Demand Forecast Model.

This study also reaffirmed and validated Metrorail and VRE as statewide economic drivers. The economic impact assessment reveals the following:

- $1.00 of state investment into the combined Metrorail and VRE services brings $2.50 in return.
- VRE and Metrorail support 130,500 jobs and 85,000 households, which collectively generate $600M annually through sales and income taxes.

Economic and Societal Impact of Hampton Roads Transit

The "*Economic and Societal Impact of Hampton Roads Transit*", prepared for the Hampton Roads Transit (HRT) by the Economic Development Research Group, was published in June 23, 2016. The objectives of the study were threefold: 1. to characterize sectors of Hampton Roads regional economy supported by transit, 2. to quantify performance benefits and impacts of the HRT system, and 3. to bring transit's story to life.

HRT is the primary provider of the regional transit services serving the Virginia Beach–Norfolk–Newport News, VA–NC Metropolitan Statistical Area as defined by the US Census, which includes over 527 square miles and 1.7M people. Currently, HRT's service area covers Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach.

The primary occupations in the HRT service area are (1) office and admin support, (2) sales, (3) food preparation/serving for restaurants/hospitality, (4) education at universities and community colleges, (5) transportation and moving material, (6) health care, and (7) business/finance operations. These top seven occupations comprise 60 percent of all jobs in the six city service area. Many service-oriented occupations have staff that heavily rely on HRT. For instance, 10 percent of state employees work in healthcare and many essential health care establishments depend highly on transit for employees working in food service, nursing, and facility maintenance. The Tidewater Community College (TCC)

student population also depends heavily on transit. TCC students can receive discounted access to HRT's transit network through the GoPass program. Users of the GoPass program make up nearly 32 percent of all light rail passengers.

The local economy demands workforce access to shipyards, hospitality and tourism sites, high-value manufacturing sites, and educational resources. These industries drive the local economy and workers in these industries depend on transit to commute.

HRT provided over 16M trips in FY2015 (Jul 2014 - Jun 2015). Nearly 88 percent of the trips were made by bus, 9 percent by light rail (LRT), and the remaining 3 percent by either ferry or paratransit. Fifteen (15) percent of riders were full-time students while 58 percent of riders were employed at full time jobs. The most common destinations of transit riders were home, workplace, colleges/universities, and destinations to complete personal business (i.e. social visits, shopping, and medical appointments). Within HRT's six city service area, transit only captured 2 percent of overall commute trips (i.e., travel from home to work and from work to home).

In FY2015, HRT invested $100.4M in operations and maintenance to provide multimodal service. This investment directly supported employment and operations at HRT, adding value to the entire Hampton Roads economy. This investment created 1,800 jobs, which translated into $89.1M in labor income and $155.5M in output across the state.

From FY2013 to FY2015, HRT spent $7.8M on average on capital investments, which generated region-wide economic impacts through $2.0M in financial output, 12 jobs, and $655,000 of labor income within Hampton Roads.

Key HRT data employed in this analysis included:

- Annual capital outlays, by spending type (FY13-15 historical, FY17-22 planned)
- Staffing, annual operations and maintenance spending, by spending type (2015)
- Current route performance data: ridership, travel times.
- Planning reports (Connect Hampton Roads®, Virginia Beach Transit Extension DEIS; Naval Station Norfolk Transit Extension Study, Corridor Analyses)
- Hampton Roads Regional Travel Model: location-based average travel characteristics (distance, time) by mode & origin/destination.
- 2014 Origin/Destination (O/D) Survey:
    - Daily trips workplace destination: American Community Survey Public Use Microdata Sample (ACS PUMS), 2013: mean earning for transit commuters, by industry
    - Daily trips with other destinations related to participating in consumer economy, including ridership by income bracket
    - Transit ridership by trip purpose, means of transportation if O&D unavailable.

- Literature review: average annual trip frequency regarding consumer spending

- Relevant news, other published literature, & interviews/discussions with statewide organization reps, business, & institutions.

This study estimated the economic impact of a scenario in which transit did not exist using 2012 and 2014 origin-destination surveys together with trip pattern information from Hampton Roads Regional Travel Demand Model. This assessment proved transit services offers unique economic value to the area served by HRT. The following results were found:

- If transit services were unavailable, 27 percent of transit riders would forgo their trips. Of the remaining 73 percent, 56 percent would attempt to carpool with other passengers and 17 percent would either bike or walk.
- Transit services save time because it is faster than carpooling and walking.
- Transit services reduce vehicle miles traveled (VMT) region-wide.
- Transit services enable more 2-income earning households by allowing one worker uses car while the other relies on transit to travel to/from work
- Transit services enable travel to essential health care services and education.
- Transit services improve access to jobs andhelps industries and businesses reach a broader labor market.
- Transit services attract workers and employers to urban environments (Downtown Norfolk); local Call Centers as well as Shipyards rely on HRT to provide employee travel.

The economic model used in this study was IMPLAN within the context of the Transportation Regional Economic Development Information System (TREDIS) to estimate indirect and induced (multiplier) economic effects from HRT's transit services. The model estimated that riding transit instead of driving would generate $1.8B in benefits to the state over 2015-2040 (**Table 2-2**). These benefits would include savings in travel time, vehicle operating costs, safety costs, and emissions resulting from people riding transit instead of driving. Without transit access, many would be forced to stop working, costing nearly 5,360 jobs, $144.5M in labor income, and $405.3M in output to the state economy.

Table 2-2 Cumulative Expected Direct Economic Impacts Generated by Transit in Hampton Roads, Virginia 2015-2040

Expected Direct Economic Impacts	Value ($M)
Vehicle Operating Costs	$262.56
Time Savings	$743.81
Safety & Environmental	$175.14
Total	**$1,181.51**

Note:

1. Source: EDR Group Analysis using TREDIS, discounted at 3 percent to 2015 Present Value.

The economic assessment translated the economic activity supported by HRT to jobs, wages, business output, and value added (**Table 2-3**). The analysis illustrated how HRT service directly supports state economic industry activity and includes multiplier effects from workers spending their income as well as effects upstream from suppliers. HRT supports over 20,300 jobs that provide $548.1M in labor income,

and generate $896.2M in value added (or Gross State Product) in the state economy by enabling transit commuters to gain access to employment and providing employers with access to their workforce. Consumers using HRT services to reach shopping, recreation, and health services destinations account for 1.6M trips and $93M in spending. This consumption of various goods and services by transit users supports nearly 1,200 jobs that provide $71.6M in labor income, and generate $95.6M in value added.

Table 2-3 Economic Impact on Labor Market and Consumer Spending enabled by Hampton Roads Transit

Type of Outlay	Employment (jobs)	Labor Income (2015$M)	Value Added (2015$M)	Business Output (2015$M)
Labor Market	20,351	$548.1	$896.2	$1,538
Consumer Market	1,197	$71.6	$95.6	$149.8

Note:

1. Source: The "Economic and Societal Impact of Hampton Roads Transit", prepared for the Hampton Roads Transit (HRT) by the Economic Development Research Group, was published in June 23, 2016.

Contribution of Transit Services to the Northern Virginia Economy

The "*Contribution of Transit Services to the Northern Virginia Economy*", prepared for the Northern Virginia Transportation Commission (NVTC) by the Center for Regional Analysis at George Mason University, was published in April 2015. The study focused on how the collective NVTC transit systems have impacted and enhanced Northern Virginia's economy, population, land-use planning, taxable property values, and livability.

NVTC transit services provide transit services throughout Northern Virginia as well as into the District of Columbia. NVTC transit services include WMATA's Metrorail and Metrobus, Fairfax County Connector, Virginia Railway Express (VRE), Alexandria's DASH system, PRTC's OmniRide and OmniLink, Arlington Transit (ART), Loudoun County Transit, and Fairfax City's City-University Energysaver (CUE) bus system.

While recent competition from rideshare services has caused slight declines for some transit services like the Metrobus, rail transit and suburban bus services are still the preferred option for many residents and have kept ridership overall on Metrorail, VRE, and suburban transit steady over the long run. These users depend on transit whether to commute or forgo driving as they age. Insufficient capacity, not demand, constrains growth. Collectively, over 143.8M trips were taken on NVTC system transit services in 2014 (**Table 2-4**).

This study employed a variety of local, statewide, and national data sources to demonstrate the economic value of transit to the region, including:

- Ridership levels across NVTC transit services from each transit provider;
- Economic studies from George Mason's Center of Regional Analysis;
- US 2000 Census information and American Community Survey data;
- Local articles published in the Washington Post;
- Reports from area developers like Cushman Wakefield.

Table 2-4 NVTC Systems Ridership, FY2014

Transit Service	FY2014 Ridership	Growth (%) 2002 to 2014
Metrorail (Virginia)	93,786,694	35%
Metrobus (Virginia)	21,379,716	-2%
Fairfax County Connector	10,655,021	56%
VRE	4,431,671	62%
DASH	4,238,784	55%
OmniRide and OmniLink	3,174,804	108%
ART	2,837,023	1026%
Loudoun County Transit	1,756,948	728%
CUE	826,747	-10%
All Trips	**143,807,408**	**22%**

Note:

1. Source: NVTC. Ridership for Metrorail (Virginia) represents the estimated number of Unlinked Passenger Trips (UPT) that are located in Virginia based on WMATA system-wide ridership. NVTC's formula for estimating Metrorail (Virginia) ridership was revised in FY14 (July 2013). Fiscal years may not align across systems. Loudoun County Transit added local service in FY2014.

Ridership on these transit systems has exceeded employed resident and overall population growth, and population growth has been densest along transit corridors. From 2000 to 2013, the number of census block groups in Northern Virginia with more than 25 percent of individuals using transit to commute to work increased from 6.5 percent to 14.1 percent (**Table 2-5**).

Table 2-5 Share of Census Block Groups by Percentage of Residents Commuting to Work by Transit, NVTC Jurisdictions

Range	Census Block Residents Commuting to Work by Transit		Change (%) 2000-2013
	2000	2013*	
Under 5%	32.5%	31.6%	-0.9%
5.1% to 15%	46.8%	38.7%	-8.1%
15.1% to 25%	14.2%	15.7%	1.5%
25.1% to 50%	6.2%	12.2%	6.0%
50.1% +	0.3%	1.9%	1.5%
Total	**100%**	**100%**	**22%**

Notes:

1. Sources: 2000 Census, 2009-2013 American Community Survey.
2. *The values in 2013 represents a 5-year average.

Primary findings of this study indicate the following:

- Transit service has brought regional economic growth, which is evident through increased office space, retail, housing, and jobs. For example, from 1970 to 2000, transit services collectively along the Rosslyn – Ballston corridor (which includes both high-density office space as well as mixed used urban villages) brought the following increases in development:
  - Office space increased by 348 percent to 23.3M square feet
  - Retail space increased by 17 percent to 600,000 square feet

  - 400 percent increase in housing to 21,200 units
  - 344 percent increase in jobs to 93,000 positions
- Transit services, especially Metrorail, have enhanced both the state and local economy. In 2010, $20.36B of economic activity on Northern Virginia commercial properties was accessible via transit. By 2040, the economic activity to be generated by commercial properties in Northern Virginia is expected to reach $185.1B.[1]
- Northern Virginia transit services have helped local municipalities repurpose unproductive land for parking into a more productive higher-density alternative, which has increased population, jobs, as well as market demand for commercial development throughout neighborhoods.
- Commercial office employers know being close to transit, especially rail, increases their labor market and makes them attract top young talent.
- Metrorail alone has enhanced property values near stations and has brought hundreds of millions to local jurisdictions through property taxes.
- In 2011, households with access to WMATA saved $342M because they did not have to pay to operate a car and, instead, contributed to tax revenues through increased local spending.

- Transit services have enhanced land-use and have made the labor-market more efficient, which has spurred development and redevelopment. Growth has come while new transit services are being built and after those new transit services are already operating. Roughly 3.7M square feet of new construction around four Metro stations in Tysons Corner had already started seven months before WMATA's Silver Line opened in July 2014.[2] The new construction was mixed use and included residential, office, retail, and hospitality buildings, and over 45M square feet of new construction is still expected to be built.
- Out of Northern Virginia's transit services, Metrorail, with the most frequent service and best access to local and statewide amenities, has had a significant impact on the economy through increased property values. Proximity to a Metrorail station has increased rents and home sale prices, which has generated more property tax revenues and has supported the economy.
- This increase in property value has been particularly noteworthy in Loudon County, which will open its first Metrorail stations as the Silver Line project continues. A study conducted for Loudoun County on the potential impact of two scenarios (with and without Metrorail) estimated that the economic opportunity cost (due to lower salaries and higher tax burdens for Loudoun County residents) of not extending Metrorail into the county was $3.2B (**Table 2-6**).
- VRE Commuter rail has also attracted development in and around existing and planned stations. VRE's Spotsylvania Station was built by developer SunCal, which also included a planned community with nearly 4,000 residential units and 3.7M square feet of commercial development.[3]

[1] McClain, J. and Pisarski, A. *Connecting Transportation Investment and the Economy in Metropolitan Washington*. Center for Regional Analysis, George Mason University, 2012.

[2] Munger, Paula F., Alexander J. Ragonese, and Daniela R. Stundel. The Silver Line: Envisioning a New Tysons Corner. Cushman & Wakefield, December 2013. (http://www.restonnow.com/files/2013/12/Silver-Line-Special-Report-Fall-2013.pdf.

[3] Lazo, L. VRE kicks off major expansion plan with new Spotsylvania station. The Washington Post. April 18, 2015. (http://www.washingtonpost.com/local/trafficandcommuting/vre-kicks-off-major-expansion-plan-with-a-new-spotsylvania-county-stop/2015/04/18/63576394-e1f8-11e4-b510-962fcfabc310_story.html).

Table 2-6 The Impact of Metrorail on the Loudoun County Economy: 2020, 2030, 2040

Scenario	Economic Impact ($B)			
	2012 (2012$B)	2020 (2020$B)	2030 (2030$B)	2040 (2040$B)
With Metrorail as planned = (a)	$21.2	$51.0	$115.4	$230.4
Without Metrorail = (b)	$21.2	$47.8	$104.2	$204.8
Economic Opportunity Cost = (a) – (b)	**$0.0**	**$3.2**	**$11.2**	**$25.6**

Note:

1. Source: Center for Regional Analysis.

2.2 Economic Benefits Associated with Transit Services

This section presents an overview of the benefits associated with transit investments that have been noted in research on the topic. This includes capital and operating spending, improved transportation systems performance, transit-oriented development (including urban redevelopment), property prices, economic competitiveness (e.g., effects on business retention and attraction and quality of life), workforce mobility, traffic safety, and air quality. The reviewed sources are listed in **Table 2-7** and a listing of the benefits generated by transit services as evidenced by these sources is provided in **Table 2-8**.

Table 2-7 Review Sources on Economic Benefits Associated with Transit Services

Reference Number	Reference Name
1	Cambridge Systematics with Economic Development Research Group (1999), *Public Transportation and the Nation's Economy: A Quantitative Analysis of Public Transportation's Economic Impact*, American Public Transportation Association (APTA)
2	EDRG (2014), *Economic Impact of Public Transportation Investment*, American Public Transportation Association (APTA)
3	Scott Goldsmith, Mary Killorin and Eric Larson (2006), T*he Economic Benefits of Public Transportation in Anchorage*, Institute of Social and Economic Research, University of Alaska Anchorage, for the Public Transportation Department, Municipality of Anchorage
4	Glen Weisbrod and Arlee Reno (2009), *Economic Impact of Public Transportation Investment*, American Public Transportation Association (APTA)
5	Cambridge Systematics, Inc. and Apogee Research, Inc. (1996), *Measuring and Valuing Transit Benefits and Disbenefits Summary*, Transit Cooperative Research Program (TCRP) Report 20, Transportation Research Board (TRB)
6	Cambridge Systematics, Inc. with Robert Cervero, and David Aschauer (1998) *Economic Impact Analysis of Transit Investments: Guidebook for Practitioners*, Transportation Cooperative Research Program (TCRP) Report 35, Transportation Research Board (TRB)
7	ECONorthwest and PBQD (2002), *Estimating the Benefits and Costs of Public Transit Projects*, TCRP Report 78

Reference Number	Reference Name
8	Todd Litman (2008), *Valuing Transit Service Quality Improvements*, Journal of Public Transportation, Vol. 11, No. 2, Spring, pp. 43-64
9	Cambridge Systematics, Inc. (2017) Capital Metropolitan Transportation Authority (*CMTA) Economic Benefit Analysis*
10	Robert Cervero, et al. (2004), *Transit-Oriented Development in the United States: Experience, Challenges, and Prospects*, Transit Cooperative Research Program (TCRP), Transportation Research Board (TRB)
11	CNT (2010), *Transit-Oriented Development and the Potential for VMT-related Greenhouse Gas Emissions Reduction*, Center for Neighborhood Technology
12	CTS (2009), *Understanding the Impacts of Transitways: The Hiawatha Line: Impacts on Land Use and Residential Housing Value*, Transitway Impacts Research Program (TIRP), Center for Transportation Studies, University of Minnesota
13	EDRG (2007), *Time is Money: The Economic Benefits of Transit Investment*, Economic Development Research Group for the Chicago RTA
14	Todd Litman (2004), *Rail Transit in America: Comprehensive Evaluation of Benefits*, Victoria Transport Policy Institute (VTPI)
15	Robert Cervero (2003), *Effects of Light and Commuter Rail Transit on Land Prices: Experiences in San Diego County*
16	Chatman, et al. (2012), *Methodology for Determining the Economic Development Impacts of Transit Projects*, Web-only Document 56, Transit Cooperative Research Program (TCRP), Transportation Research Board (TRB)
17	Crain & Associates (1999), *Using Public Transportation to Reduce the Economic, Social, and Human Costs of Personal Immobility*, Transit Cooperative Research Program (TCRP) Report 49, Transportation Research Board (TRB)
18	CTS (2010), *How Light-Rail Transit Improves Job Access for Low-Wage Workers*, A Transitway Impacts Research Program (TIRP) Research Brief, Center for Transportation Studies, University of Minnesota
19	Christopher Porter, Jonathan Lee, Taylor Dennerlein and Paula Dowell (2015), *Selected Indirect Benefits of State Investment in Public Transportation*, Research Results Digest 393, NCHRP Project 20-65, Task 52, National Cooperative Highway Research Program
20	Weisbrod, et al. (2017), *Practices for Evaluating the Economic Impacts and Benefits of Transit*, Transportation Cooperative Research Program (TCRP) Report 128, Transportation Research Board (TRB)
21	MacPherson Hughes-Cromwick and Matthew Dickens (2018), *2017 Public Transportation Fact Book,* American Public Transportation Association (APTA)
22	CJI Research Corporation (2017), *Who Rides Public Transportation,* American Public Transportation Association (APTA)
23	Todd Litman (2017), *Evaluating Public Transit Benefits and Costs Best Practices Guidebook*, Victoria Transport Policy Institute (VTPI)
24	Todd Litman (2018), *Evaluating Public Transit Criticism: Systematic Analysis of Political Attacks on High Quality Transit, and How Transportation Professionals Can Effectively Respond*, Victoria Transport Policy Institute (VTPI)
25	Todd Litman (2016), *Transportation Cost and Benefit Analysis II – Safety and Health Costs,* Victoria Transport Policy Institute (VTPI)
26	Center for Regional Analysis at George Mason University, *Contribution of Transit Services to the Northern Virginia Economy* (April 2015), prepared for the Northern Virginia Transportation Commission (NVTC).

Reference Number	Reference Name
27	EDRG, *Economic and Societal Impact of Hampton Roads Transit* (June 23, 2016). Prepared for the Hampton Roads Transit (HRT).
28	Northern Virginia Transportation Commission, *The Value of Metrorail and the Virginia Railway Express to the Commonwealth of Virginia, July 2018.*

Table 2-8 Economic Benefits Associated with Transit Services

Economic Benefits from:	Direct or Long-Term Economic Benefits	Sources
Transit Capital and Operations Spending	Increased employment	1, 2, 3, 4, 5, 6, 9, 21
	Increased income	1, 2, 3, 4, 5, 9, 20
	Indirect and induced demand	2, 3
	Increased tax revenue	2, 9, 20, 21, 26, 27, 28
Improved Transit System Performance	Reduced cost for transit users	1, 3, 7, 8, 9, 14, 20, 22, 23, 24
	Increased fare revenue	8, 22
	Increased dependability, reduced buffer time	3, 5, 8
	Reduced parking costs	3, 7, 8, 14, 22, 23, 24
	Chauffeuring savings	3, 14, 23, 24
	Taxi fare savings	3
	Provide comfort and convenience	5, 8, 22, 23, 24
	Increased user safety	7, 14, 23, 24, 25
	Mode option value	5, 7, 14, 23, 24
	Reduced roadway congestion from mode switch	2, 5, 7, 8, 9, 14, 23, 24
	Reduced vehicle-miles traveled (VMT)	2, 9, 10, 27
	Reduced vehicle operating costs (VOC)	9, 24, 26, 28
	Reduced roadway delay	3, 28
	Reduced road expenditure and other infrastructure outlays	7, 8, 9, 14, 20, 23, 24
	Reduced crash costs	3, 7, 8, 14, 20, 27
	Reduced cost of doing business	1, 2, 9
	Reduced energy use	5, 7, 9, 14, 23, 27
Transit Oriented Development (TOD)	Increased ridership	10, 13, 26
	Joint development opportunities	10
	Revitalization of neighborhoods	6, 10
	Economic development	6, 10, 14
	Increase land value	10
	Increased retail sales	10
	Increased property and sales tax	9, 10, 12, 24, 26, 28
	Affordable housing opportunities	10
	Reduced sprawl	5, 7, 10, 26, 27
	Increased labor pool access	10, 27
	Reduced parking costs	7, 10
	Reduced crime/Increased user security	5, 10, 23
	Less congestion from access to transit	10, 23, 28

Economic Benefits from:	Direct or Long-Term Economic Benefits	Sources
	Reduced emissions	10, 11, 20, 27
	Increased livability	5, 14, 24, 26
	Increased public health	14, 20, 23, 24, 25, 26
Improved Mobility and Accessibility	Increased access to employment	2, 3, 7, 17, 18, 19, 20, 26, 27, 28
	Reduced unemployment	17, 19, 28
	Increased mobility for low-income populations	7, 18, 23, 24
	Increased access to health care	3, 17, 19, 27
	Reduced health care cost	3, 14, 17, 19
	Increased accessibility	23, 24
	Increased access to education	3, 7, 19, 20, 27
	Increased access to social services	3
	Increased access to shopping	3
	Increased access to recreation/social activities	7
	Increased access to tourism destinations	3
	Reduced barrier effects - for non-motorized transportation	3, 5, 7, 23
Environmental Sustainability	Reduced air pollution/emissions	3, 5, 6, 7, 8, 9, 10, 11, 13, 14, 20, 23, 24, 27, 28
	Reduced noise pollution	3, 5, 6, 7, 23
	Reduced water pollution	3, 7
	Efficient energy use	3, 5, 7, 10, 14, 24
	Efficient land use/reduced sprawl	3, 5, 7, 10, 23, 26
Property Prices	Increased property value near station areas	4, 6, 10, 12, 15, 20, 24
Economic Competitiveness	Decreased cost of doing business	1
	Reduced congestion	1, 23, 26, 27, 28
	Worker wages, reliability, turnover	2, 3, 9
	Increased business productivity - increased labor pool access	1, 2, 4, 5, 9, 10, 20, 24, 26, 27, 28
	Attraction of businesses/economic development	1, 6, 7, 10, 14, 20, 26, 27, 28
	Agglomeration economies	5, 6, 16, 24, 20
	Statewide business growth from indirect and induced demand	2, 6
	Increased system performance	2
	Increased tax revenue from wages/corporate profits	2, 6, 28

2.3 Initial Stakeholder Outreach

The focus of the initial outreach effort consisted of in-person and telephone interviews with DRPT staff. The purpose of these interviews was to gain insight into the various stakeholders' perspectives regarding transit benefits and challenges today and desired outcomes from this study. These interviews built upon the lessons learned from the literature review and the areas of greatest opportunity for implementing the final methodology. Takeaways from these interviews include the following:

- **Funding –** SMART SCALE, an important source of capital revenues that the Commonwealth used for surface transportation projects, and the MERIT - Transit Capital Assistance Program have helped DRPT to cover a portion of the anticipated funding deficit for transit projects. As demand for transit

increases in Virginia, DRPT is facing shortfalls for capital and operating funds. The outcomes of this study will support future requests for additional transit funding by DRPT.

- **Improved Quality of Life –** Transit services in Virginia have improved the quality of life for residents regardless of whether they use the system. Transit services have maximized existing infrastructure by increasing person-throughput utilizing available roadway capacity. As traffic levels in Virginia have increased and transit services have expanded, transit services have become more vital to mitigate roadway congestion, reducing travel delays and fuel spending. Transit services have also lowered costs associated with air pollutants and traffic accidents, generating environmental and safety benefits in the state. Transit services in rural communities have provided access to jobs and health services, particularly for people with limited ability to drive.

- **Promotes Economic Prosperity –** Transit services in Virginia has allowed firms to access a wider labor pool while the workers in the labor pool have enhanced access to employment opportunities. Transit services have enabled people who do not drive or do not own a car to participate in economic activity which has helped to reduce government spending on social services.

- **Adds Value to the Community -** Proximity to transit facilities has increased the value of nearby residential, commercial, and retail properties. While these higher property values may be balanced by lower values elsewhere, transit agencies have contributed directly to the state economy by generating employment opportunities, and by purchasing goods and services from firms throughout the state.

The desired outcomes of this study are as follows:

- To improve DRPT's ability to summarize the full range of quantitative and qualitative benefits that transit brings to Virginia's economy.

- To better articulate what transit use needs are, how transit drives Virginia's economy, how transit use brings economic development opportunities (particularly in the areas proximal to transit stations), and the total value and economic impact of transit use on the state in terms of jobs, labor income, gross state product (value added), and tax revenue.

- To distinguish between the benefits accruing to rural areas from the benefits accruing to urban areas and ensure transit brings benefits to rural as well as urban communities in Virginia. The magnitude of the benefits is expected to be higher in the urban areas, but ridership has grown significantly in rural areas in Virginia.

- To demonstrate the return on investment in transit services in Virginia.

- To address the perception that transit use is inefficient because buses occasionally run empty. Most transit vehicles have times when they are nearly or completely full, but occasionally buses are empty due to fluctuating demand. While buses operate at times and location where demand is low, demand for transit service is concentrated on the corridors with the greatest traffic congestion and parking problems which has enabled transit services to provide economic benefits in these areas.

- To address the perception that transit services are for low-income people unable to afford cars. Transit services have supported local Virginia economies by connecting non-drivers (e.g., people with

disabilities, youths, the elderly) with job opportunities and needed services. Transit services have also supported tourism by attracting car-free tourism (or visitors without their cars) which has brought many benefits to local areas and their economies.

2.4 Takeaways

Transit services have provided a range of benefits, from providing better utilization of existing roadway capacity to acting as a driver of economic opportunity and development. The presence of statewide transit services has provided transportation choices, reduced travel and vehicle ownership costs, and decreased traffic congestion for auto users and commercial vehicles. Reduced congestion has lowered operations costs for business travelers and industries transporting commodities. Finally, transit has improved access to larger labor markets with more diverse skills, and this larger number and diversity of workers available to businesses has improved business productivity, which has grown their market shares relative to their competitors in other states.

Transit services have played an important role in supporting denser land use patterns, reducing vehicle travel, reducing harmful emissions, and reducing energy use. Transit-oriented development (TOD) paired with reductions in automobile travel and traffic congestion has resulted in substantially less emissions. Economic benefits from transit use also include improved public health and fitness from increases in walking and biking. TOD neighborhoods have added benefits of encouraging economic development, improving livability, and increasing property values, and requiring less parking and roads.

Furthermore, transit systems have become essential to connecting people to jobs, particularly for low-income households and people with no access to a car (e.g., students, seniors, and persons with disabilities). The agglomeration benefits of concentrating employment near transit accrue to both employers and employees. Transit services have provided firms with access to a wider labor pool while the workers in that labor pool have enhanced access to employment. This has been especially important for lower-income workers for whom automobile ownership may be a significant economic hardship. Transit services have also fostered pedestrian-friendly environments and urban amenities that help attract as well as retain employees.

3.0 Analysis Methodology

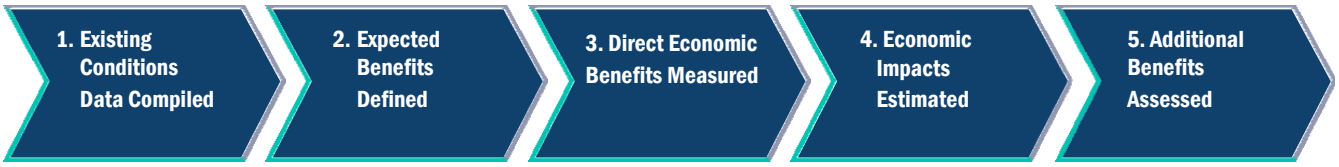
3.1 Analytical Framework

This study assessed how existing transit services and operations generate economic value to the Commonwealth of Virginia. The study utilized data on system performance, capital investments, and operating expenses for all 41 agencies operating transit services in the state in FY2018 to arrive at the economic impact findings. The methodology described in this section was used to estimate economic impacts from transit services throughout the state. Specifically, the following ***economic impact components*** were estimated:

- **Direct impacts** – Economic benefits that are directly derived from the presence of transit (e.g. transit agency employment).
- **Indirect impacts –** Industry-to-industry interactions in response to the changes in transportation investments, costs, and demands (e.g. employment with companies that support the transit industry).
- **Induced effects –** Changes in household spending as total income and population adjust based on the direct impacts of transit investment. (e.g. the wages of transit employees lead to increased retail sales).

Figure 3-1 presents a flowchart of the overall study methodology.

Figure 3-1 Study Methodology



1. **Data on Existing Conditions Were Compiled**: The study team defined transit agency spending and performance data for all Virginia transit services included in this analysis.
2. **Expected Direct Economic Benefits Were Defined**: The study team identified the types of direct impacts and potential metrics to quantify them. Only those impacts that could be monetized were analyzed in greater detail in Steps 3 and 4. The ***direct monetized economic benefits*** were categorized into the following types:
    - **Enterprise Spending Benefits –** This includes the benefits associated with direct payroll, non-payroll, and capital spending by the agencies operating transit services in Virginia that ripple through the state economy.
    - **Congestion Relief Benefits –** This includes benefits attributed to a reduction in the number of trips on roadways throughout the state due to the presence of transit as an option. Less congestion leads to reduced travel times and costs associated with delays.

- **Increased / Affordable Mobility Benefits –** This category captures the benefits that come from providing additional, more affordable travel options to those living in communities with access to transit. This includes the economic activity generated by providing mobility, cost savings, and access to employment opportunities to those without access to personal vehicles.

- **Other Community Impacts –** This includes reduced costs associated with vehicle crashes, reduced emissions and fuel consumption, and reduced maintenance costs of roadway infrastructure.

3. **Expected Direct Economic Benefits Were Measured**: The direct benefits accruing to transit users, highway users, and the general population of Virginia were measured based on transit use in FY2018. In doing so, this step assumed what travel behavior would look like in the absence of public transportation throughout the state. If transit did not exist in Virginia, some would-be transit riders would inevitably have to shift to other transportation modes while others would forgo their trips entirely. The estimates of mode shift and forgone trips due to the absence of transit as an option were used to calculate the direct economic benefits generated by the existing transit system.

4. **Wider Economic Impacts Were Estimated**: This step translated the direct economic impacts into the necessary inputs needed to run an economic model. This study used the IMPLAN economic model to estimate the total economic impacts (direct, indirect, and induced). The results included estimated changes in Virginia's economy due to the presence of transit throughout the state. The resulting ***economic impacts*** were reported in terms of the following categories:

   - **Employment (Jobs) –** This is the estimate of the number of jobs (full and part time) by place of work generated by an investment. Full-time and part-time jobs were given equal weight in this analysis.

   - **Labor Income –** This is a measure of wages and benefits associated with the additional employment generated.

   - **Gross State Product (GSP) –** This captures the additional value created in the production process, which includes employee compensation (labor income), proprietor income (i.e., payments received by self-employed individuals as income), other income types, and indirect business taxes.

   - **Tax Revenue –** This is the increase in property and sales tax revenue to the local government, as well as changes in income tax revenues and taxes on production and imports for the federal and state government, that are realized when local resident and business activity changes.

   Additional information on the use of the IMPLAN model is provided in **Appendix A**.

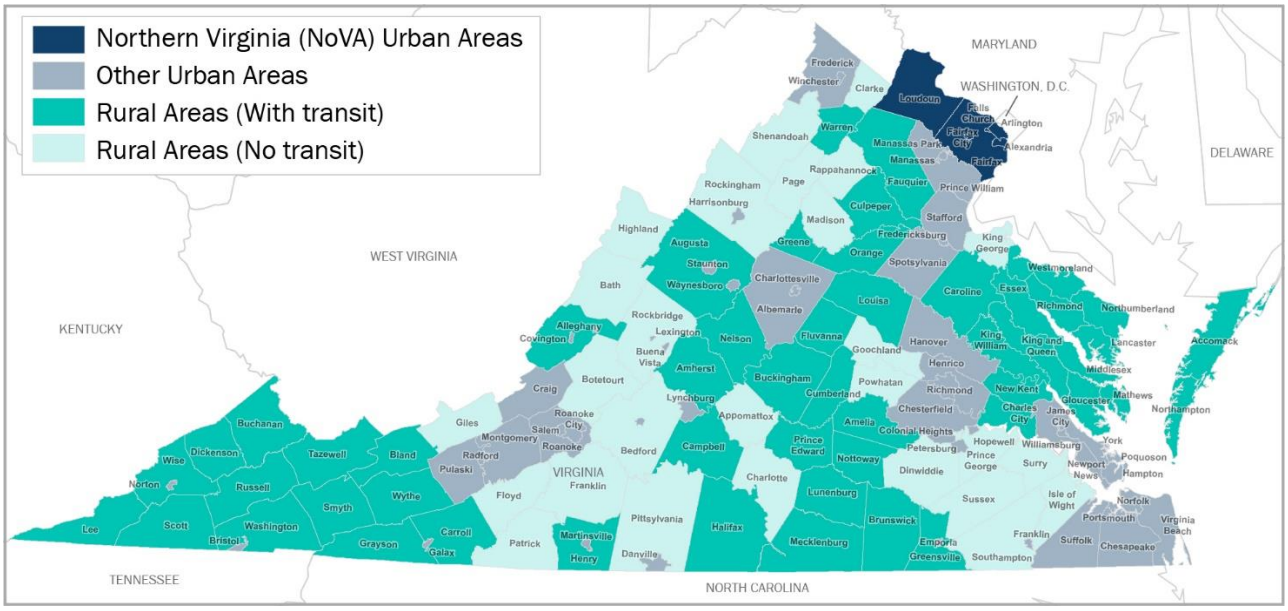
5. **Additional Transit Benefits Were Assessed**: In addition to the benefits and economic impacts addressed in Steps 2 through 4, other benefits that are generated from the presence of transit were assessed. These benefits are generally difficult to reliably quantify but should be considered in the decision-making process regarding transit investments. This analysis conducted a qualitative assessment of these additional benefits.

3.2 Geographic Resolution of the Analysis

This study calculated the total economic benefits and impacts generated by public transportation spending statewide, and provided results for three sub-regions throughout the state as shown in **Figure 3-2**. These included:

- **Northern Virginia (NoVA) Urban Areas:** Urbanized jurisdictions in the Metropolitan Washington Region;
- **Other Urban Areas:** VA jurisdictions where more than 50% of the population lives in areas classified as urban; and
- **Rural Areas**: VA jurisdictions where more than 50% of the population lives in areas classified as rural.

Figure 3-2 Sub-Region Designations by County & City for the Commonwealth of Virginia



The U.S. Census Bureau identifies two types of urban areas: Urbanized Areas (UAs) of 50,000 or more people and Urban Clusters (UCs) of at least 2,500 and less than 50,000 people. "Rural" encompasses all population, housing, and territory not included within an urban area.[4] The U.S. Census Bureau also provided the county rurality level for all counties in the U.S. based on the following definitions:

- Counties with less than 50 percent of the population living in rural areas are classified as 'mostly urban'.
- Counties with between 50 percent and 99.9 percent of the population living in rural areas are classified as 'mostly rural'.

[4] Michael Ratcliffe, Charlynn Burd, Kelly Holder, and Allison Fields. Defining Rural at the U.S. Census Bureau. American Community Survey and Geography Brief. Issued December 2016. Available at https://www2.census.gov/geo/pdfs/reference/ua/Defining_Rural.pdf

Counties with 100 percent of the population living in rural areas are classified as 'completely rural'. **Table 3-1** shows the counties in Virginia which are 'mostly rural' and 'completely rural'. This analysis used the county rurality level provided by the U.S. Census Bureau to estimate the economic benefits accruing to Virginia rural areas(i.e. 'mostly rural' and 'completely rural counties) and urban areas(i.e. 'mostly urban counties) based on the service areas of each transit agency (see **Table 3-2**).

Table 3-1 Rural Counties in Virginia

2015 Geography Name	2010 Census Total Population	2010 Census Urban Population	2010 Census Rural Population	2010 Census Percent Rural
Accomack County, Virginia	33,164	0	33,164	100.0
Alleghany County, Virginia	16,250	7,736	8,514	52.4
Amelia County, Virginia	12,690	0	12,690	100.0
Amherst County, Virginia	32,353	11,756	20,597	63.7
Appomattox County, Virginia	14,973	0	14,973	100.0
Augusta County, Virginia	73,750	24,752	48,998	66.4
Bath County, Virginia	4,731	0	4,731	100.0
Bedford County, Virginia	68,676	14,812	53,864	78.4
Bland County, Virginia	6,824	0	6,824	100.0
Botetourt County, Virginia	33,148	11,901	21,247	64.1
Brunswick County, Virginia	17,434	4,270	13,164	75.5
Buchanan County, Virginia	24,098	0	24,098	100.0
Buckingham County, Virginia	17,146	0	17,146	100.0
Campbell County, Virginia	54,842	21,326	33,516	61.1
Caroline County, Virginia	28,545	6,165	22,380	78.4
Carroll County, Virginia	30,042	858	29,184	97.1
Charles City County, Virginia	7,256	0	7,256	100.0
Charlotte County, Virginia	12,586	0	12,586	100.0
Clarke County, Virginia	14,034	4,277	9,757	69.5
Craig County, Virginia	5,190	0	5,190	100.0
Culpeper County, Virginia	46,689	17,778	28,911	61.9
Cumberland County, Virginia	10,052	402	9,650	96.0
Dickenson County, Virginia	15,903	0	15,903	100.0
Dinwiddie County, Virginia	28,001	8,062	19,939	71.2
Essex County, Virginia	11,151	2,534	8,617	77.3
Fauquier County, Virginia	65,203	27,714	37,489	57.5
Floyd County, Virginia	15,279	0	15,279	100.0
Fluvanna County, Virginia	25,691	9,528	16,163	62.9
Franklin County, Virginia	56,159	6,048	50,111	89.2
Giles County, Virginia	17,286	5,828	11,458	66.3
Gloucester County, Virginia	36,858	13,038	23,820	64.6
Goochland County, Virginia	21,717	653	21,064	97.0
Grayson County, Virginia	15,533	19	15,514	99.9
Greene County, Virginia	18,403	8,973	9,430	51.2
Greensville County, Virginia	12,243	1,590	10,653	87.0
Halifax County, Virginia	36,241	8,306	27,935	77.1
Henry County, Virginia	54,151	21,270	32,881	60.7
Highland County, Virginia	2,321	0	2,321	100.0
Isle of Wight County, Virginia	35,270	15,030	20,240	57.4
King and Queen County, Virginia	6,945	0	6,945	100.0
King George County, Virginia	23,584	6,323	17,261	73.2
King William County, Virginia	15,935	2,675	13,260	83.2

2015 Geography Name	2010 Census Total Population	2010 Census Urban Population	2010 Census Rural Population	2010 Census Percent Rural
Lancaster County, Virginia	11,391	0	11,391	100.0
Lee County, Virginia	25,587	112	25,475	99.6
Louisa County, Virginia	33,153	0	33,153	100.0
Lunenburg County, Virginia	12,914	0	12,914	100.0
Madison County, Virginia	13,308	0	13,308	100.0
Mathews County, Virginia	8,978	0	8,978	100.0
Mecklenburg County, Virginia	32,727	7,262	25,465	77.8
Middlesex County, Virginia	10,959	0	10,959	100.0
Nelson County, Virginia	15,020	0	15,020	100.0
New Kent County, Virginia	18,429	0	18,429	100.0
Northampton County, Virginia	12,389	0	12,389	100.0
Northumberland County, Virginia	12,330	0	12,330	100.0
Nottoway County, Virginia	15,853	7,555	8,298	52.3
Orange County, Virginia	33,481	14,136	19,345	57.8
Page County, Virginia	24,042	4,770	19,272	80.2
Patrick County, Virginia	18,490	0	18,490	100.0
Pittsylvania County, Virginia	63,506	9,126	54,380	85.6
Powhatan County, Virginia	28,046	91	27,955	99.7
Prince Edward County, Virginia	23,368	8,597	14,771	63.2
Prince George County, Virginia	35,725	16,647	19,078	53.4
Rappahannock County, Virginia	7,373	0	7,373	100.0
Richmond County, Virginia	9,254	0	9,254	100.0
Rockbridge County, Virginia	22,307	1,865	20,442	91.6
Rockingham County, Virginia	76,314	31,035	45,279	59.3
Russell County, Virginia	28,897	3,414	25,483	88.2
Scott County, Virginia	23,177	4,143	19,034	82.1
Shenandoah County, Virginia	41,993	14,032	27,961	66.6
Smyth County, Virginia	32,208	7,960	24,248	75.3
Southampton County, Virginia	18,570	378	18,192	98.0
Surry County, Virginia	7,058	0	7,058	100.0
Sussex County, Virginia	12,087	0	12,087	100.0
Tazewell County, Virginia	45,078	21,688	23,390	51.9
Warren County, Virginia	37,575	18,634	18,941	50.4
Washington County, Virginia	54,876	15,543	39,333	71.7
Westmoreland County, Virginia	17,454	3,693	13,761	78.8
Wise County, Virginia	41,452	17,961	23,491	56.7
Wythe County, Virginia	29,235	7,212	22,023	75.3

Note:

1. Data Source: U.S. Census Bureau, available at https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html

Table 3-2 Virginia Urban and Rural Areas Served by Transit

	Agency	Service Areas	Urban and Rural Areas*
1	Alexandria Transit Company	Alexandria	Alexandria City (Urban)
2	Altavista Community Transit System (ACTS)	Altavista	Campbell (Rural)
3	Arlington County Transit (ART)	Arlington	Arlington (Urban)
4	Bay Transit	Charles City, Essex, Gloucester, King and Queen, King William, Lancaster, Mathews, Middlesex, New Kent, Northumberland, Richmond County, and Westmoreland	Charles City Co. (Rural) Essex (Rural) Gloucester (Rural) King and Queen (Rural) King William (Rural) Lancaster (Rural) Matthews (Rural) Middlesex (Rural) New Kent (Rural) Northumberland (Rural) Richmond County (Rural) Westmoreland (Rural)
5	Blacksburg Transit	Blacksburg	Montgomery (Urban)
6	Blackstone Area Bus System (BABS)	Amelia, Blackstone, Brunswick, Buckingham, Cumberland, Lunenburg, Nottoway, and Prince Edward	Amelia (Rural) Brunswick (Rural) Buckingham (Rural) Cumberland (Rural) Lunenburg (Rural) Nottoway (Rural) Prince Edward (Rural)
7	Bristol Virginia Transit	Bristol	Bristol City (Urban)
8	Central Shenandoah Planning District Commission (BRITE)	Augusta, Staunton, and Waynesboro	Augusta (Rural) Staunton City (Urban) Waynesboro City (Urban)
9	Charlottesville Area Transit (CAT)	Albemarle, Charlottesville	Albemarle (Urban) Charlottesville City (Urban)
10	Chincoteague Pony Express	Chincoteague	Town of Chincoteague (Unknown- assumed mostly urban)
11	City of Fairfax (CUE)	Fairfax City	Fairfax City (Urban)
12	Danville Transit	Danville	Danville City (Urban)
13	District Three Public Transit (Mountain Lynx)	Abingdon, Bland, Carroll, Galax, Grayson, Marion, Smyth, Wythe, Wytheville, and Washington	Washington (Rural) Bland (Rural) Carroll (Rural) Galax City (Urban) Grayson (Rural) Smyth (Rural) Wythe (Rural)
14	Fairfax County (Fairfax Connector)	Fairfax County	Fairfax (Urban)
15	Farmville Area Bus (FAB)	Farmville	Prince Edward (Rural) Cumberland (Rural)

	Agency	Service Areas	Urban and Rural Areas*
16	Four County Transit	Buchanan, Dickenson, Russell, and Tazewell	Buchanan (Rural) Dickenson (Rural) Russell (Rural) Tazewell (Rural)
17	Fredericksburg Regional Transit (FRED)	Caroline, Fredericksburg, Spotsylvania, and Stafford	Caroline (Rural) Fredericksburg City (Urban) Spotsylvania (Urban) Stafford (Urban)
18	Graham Transit	Bluefield	Tazewell (Rural)
19	Greater Lynchburg Transit Company (GLTC)	Amherst and Lynchburg	Amherst (Rural) Lynchburg City (Urban)
20	Greater Richmond Transit Company (GRTC)	Chesterfield, Henrico, and Richmond	Chesterfield (Urban) Henrico (Urban) Richmond City (Urban)
21	Greater Roanoke Transit Company (Valley Metro)	Roanoke	Roanoke City (Urban)
22	Greene County Transit	Greene County	Greene (Rural)
23	Greensville-Emporia Transit	Greensville and Emporia	Greensville (Rural) Emporia City (Urban)
24	Hampton Roads Transit (HRT)	Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, and Virginia Beach	Chesapeake City (Urban) Hampton City (Urban) Newport News City (Urban) Norfolk City (Urban) Portsmouth City (Urban) Virginia Beach City (Urban)
25	Harrisonburg Department of Public Transportation (HDPT)	Harrisonburg	Harrisonburg City (Urban)
26	JAUNT	Albemarle, Buckingham, Charlottesville, Fluvanna, Louisa, and Nelson	Albemarle (Urban) Buckingham (Rural) Charlottesville City (Urban) Fluvanna (Rural) Louisa (Rural) Nelson (Rural)
27	Lake Country Area Agency on Aging	Brunswick, Halifax, and Mecklenburg	Brunswick (Rural) Halifax (Rural) Mecklenburg (Rural)
28	Loudoun County (LC Transit)	Loudoun County	Loudoun (Urban)
29	Mountain Empire Older Citizens (MEOC)	Lee, Norton, Scott, and Wise	Lee (Rural) Norton City (Urban) Scott (Rural) Wise (Rural)
30	Petersburg Area Transit (PAT)	Petersburg	Petersburg City (Urban)
31	Potomac and Rappahannock Transportation Commission (PRTC) (Omniride, OmniLink)	Manassas, Manassas Park, and Prince William	Manassas City (Urban) Manassas Park City (Urban)

	Agency	Service Areas	Urban and Rural Areas*
			Prince William (Urban)
32	Pulaski Area Transit (PAT)	Pulaski	Pulaski (Urban)
33	RADAR	Alleghany, Clifton Forge, Covington, Henry, Lexington, Martinsville, Roanoke, and Rockbridge	Alleghany (Rural) Covington City (Urban) Henry (Rural) Lexington City (Urban) Roanoke (Urban) Roanoke City (Urban)
34	Radford Transit	Radford	Radford City (Urban)
35	STAR Transit	Accomack and Northampton	Accomack (Rural) Northampton (Rural)
36	Suffolk Transit	Suffolk	Suffolk City (Urban)
37	Virginia Railway Express (VRE)	Alexandria, Fairfax, Fredericksburg, Manassas, Manassas Park, Prince William, Spotsylvania, and Stafford	Alexandria City (Urban) Fairfax (Urban) Fairfax City (Urban) Fredericksburg City (Urban) Manassas City (Urban) Manassas Park City (Urban) Prince William (Urban) Spotsylvania (Urban) Stafford (Urban)
38	Virginia Regional Transit (VRT)	Culpeper, Fauquier, Loudoun, Orange, and Warren	Culpeper (Rural) Fauquier (Rural) Loudoun (Urban) Orange (Rural) Warren (Rural)
39	Winchester (WinTran)	Winchester	Winchester City (Urban)
40	Williamsburg Area Transit (WATA)	James City, Williamsburg, and York	James City Co. (Urban) Williamsburg City (Urban) York (Urban)
41	Washington Metropolitan Area Transit Authority (WMATA)	Alexandria, Arlington, Fairfax County, Fairfax City, Falls Church, and Loudoun	Alexandria City (Urban) Arlington (Urban) Fairfax (Urban) Fairfax City (Urban) Falls Church City (Urban) Loudoun (Urban)

Note:

1. *Estimated based on information from the U.S. Census Bureau, available at https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural.html

3.3 Transit Mode Characteristics

The following information regarding characteristics of transit modes in Virginia was used in the process of estimating economic benefits:

- WMATA's heavy rail (or Metrorail) uses self-propelled electric-powered passenger railcars operating on a dedicated and grade-separated right-of-way, either above or below-ground. The heavy rail accommodates very high passenger volumes and trains are operated in multicar sets. The electricity to power the vehicles is drawn either from overhead wires or from a power rail.

- Light rail operated by HRT (The Tide) uses self-propelled electric-powered passenger railcars operating on an exclusive or shared above-ground right-of-way to provide scheduled service. The Tide accommodates lower passenger volumes than the heavy rail operated by WMATA, and passenger cars are operated either singly or in two-car sets. The electricity to power the vehicles is drawn from overhead wires.

- Commuter rail operated by VRE uses electric or diesel-powered locomotives pulling passenger cars and operates on a share rail right-of-way on track leased from Norfolk Southern and CSX railroads.

- Bus Rapid Transit (BRT) is a high-quality, high-capacity rapid transit system that operates on dedicated lanes, with busways and iconic stations typically aligned to the center of the road, off-board fare collection, and fast and frequent service. BRT systems are operated in Arlington, Alexandria, and most recently in Richmond.

- Local (non-WMATA) fixed-route buses are primarily diesel-powered, rubber-tired vehicles that operate in mixed traffic. Sixty (60) percent of the fleet runs on diesel fuel, 25 percent are hybrid diesel/electric vehicles, 12 percent are fueled with CNG, and 3 percent are fueled with gasoline.

- The distribution of WMATA Metrobus fleet by fuel type is as follows: 52 percent of the fleet are hybrid diesel/electric vehicles, 29 percent are fueled with CNG, 10 percent are fueled with clean diesel, and 9 percent are fueled with standard diesel.[5]

- Demand response buses operate in response to calls from passengers to a transit operator, who schedules a vehicle to pick up the passengers to transport them to their destinations. Paratransit vans provide door-to-door service to individuals that live within ¾ mile of fixed route services that have disabilities that preclude them from using fixed-route transit bus service. Demand response and paratransit buses and vans are primarily gasoline-powered, rubber-tired vehicles. Eighty (80) percent of the fleet is powered with gasoline, eight (8) percent with diesel, five (5) percent with CNG, and the remaining seven (7) percent uses other type of fuels.[6]

- The ferry service operated by HRT uses marine vessels to carry passengers. The vessels are steam or diesel powered.

[5] Washington Metropolitan Area Transit Authority, Office of Bus Planning, *2017 Metrobus Fleet Management Plan*, Final Report – July 2017 Version 2.1

[6] Ibid.

3.4 Benefit Types and Metrics

Transit systems in Virginia generate significant economic benefits for the state. The categories of direct monetized economic benefits considered in this study were defined in Section 3.1. **Table 3-3** includes the metrics used to quantify the direct economic benefits generated by transit in Virginia by benefit type. These benefits were estimated by assessing the fiscal and travel behavior impacts in the absence of transit services throughout the state. If transit did not exist, transit agencies would not hire employees, pay salaries, or purchase goods and services. In addition, some transit riders would shift to alternative transportation modes, while other riders may have to forgo their trips entirely. Estimated changes in statewide transit and automobile performance metrics were used to quantify these benefits. For transit travel, changes in Vehicle Revenue Miles (VRM), Vehicle Revenue Hours (VRH), speed, and Passenger Miles Travelled (PMT) were used, and for auto travel, changes in Vehicle Miles Travelled (VMT), Vehicle Hours Travelled (VHT), and speeds were used.

Table 3-3 Quantifiable Expected Direct Economic Impacts Arising from Transit Agency Operations and Services

Impact Type	Metrics
Enterprise Spending	Count of Full-Time Employees (FTE) at transit agencies
	Wages and Fringe Benefits (Payroll Expenses) of FTE at transit agencies
	Transit Services Operating Expenditures (Non-Payroll Expenses)
	Transit Services Capital Expenditures
Congestion Relief	Travel time savings for highway (private passenger car and transit) users
	Avoided cost of delays for highway (private passenger car and transit) users
Increased/Affordable Mobility	Net expenditure value benefit (vehicle ownership cost savings for transit riders)
	Forgone employment benefit (income for transit dependent riders)
Other: Road Traffic Safety	Net traffic crash cost savings due to private passenger car travel
	Net traffic crash cost savings due to transit vehicle travel
Other: Environmental Sustainability	Emission cost savings due to private passenger cars travel
	Emission cost savings due to transit vehicles travel
Other: State-of-Good-Repair of Infrastructure	Pavement maintenance cost savings due to car travel reductions
	Pavement maintenance cost increases due to transit vehicles

3.5 Time Frame of Analysis

The overall economic impacts analysis was limited to Fiscal Year 2018 (FY2018). The project team was able to gather most of the relevant data for FY2018. However, in instances where data was not available, dollar figures from other recent years were inflated, deflated, interpolated, or extrapolated to 2018 for input into the IMPLAN model. The Consumer Price Index for All Urban Consumers (CPI-U) provided by the Bureau of Labor Statistics (BLS) was used to estimate inflation and deflation.[7] All calculations and assumptions have been noted in this document.

3.6 Data Sources

To estimate the direct economic impacts generated by current transit operations and services in Virginia, the study used the following sources of information:

Enterprise Data

- Transit Agencies' Comprehensive Annual Financial Reports (CAFRs) for FY2018 provided by DRPT
- Counts of full-time employees (FTE) in FY2018 from the CAFRs and file "Grantees.xlxs" provided by DRPT
- Wages and fringe benefits for the 41 transit agencies
- Actual audited operating expenses (total and by category) for 40 transit agencies (excluding WMATA) in FY2018 provided by DRPT (collected as part of the FY2020 operating assistance applications). The data included payroll (FTE wages and fringe benefits) and non-payroll expenses in FY2018 for each of the 40 transit agencies
- Allocated capital funds (total and by category) for 40 transit agencies (excluding WMATA) in FY2018 provided by DRPT.
- Allocated capital funds in FY2018, and actual operating expenses in FY2017 (total and by category) for WMATA provided by DRPT.

Transit Data

- FY2018 performance data (ridership, VRM, VRH and PMT) by transit agency (excluding WMATA) provided by DRPT
- The latest adopted Transit Development Plans (TDPs) for each agency provided by DRPT
- FY2018 WMATA ridership in Virginia provided quarterly by the Northern Virginia Transportation Commission (NVTC) (http://www.novatransit.org/resources/ridership-data/), and reported in the report of the Secretary of Transportation "How the Commonwealth is Using Transit and Transportation

[7]U.S. Bureau of Labor Statistics. Consumer Price Index, All Urban Consumers, U.S. City Average, Series CUSR0000SA0. 1982-1984=100.

Demand Management to Reduce Congestion and Use of Single-Occupant Vehicles" to the General Assembly of Virginia (Commonwealth of Virginia, Richmond, 2018)

- FY2017 WMATA performance data (VRM, VRH and PMT) obtained from the National Transit Database (NTD) and Northern Virginia Transportation Commission (NVTC)
- Latest transit agencies profiles obtained from the NTD

Highway Data

- Auto average vehicle occupancy (auto AVO) and annualization factors by auto trip purpose (work, business, and “all other purpose” trips) obtained from the Virginia travel demand model (TDM)
- Daily auto vehicle-miles travel (auto VMT), auto vehicle-hours travel (auto VHT), and travel speeds by trip purpose and sub-area (statewide, urban, and rural) in the base year 2015 and future year 2025 obtained from the Virginia travel demand model (TDM)

The study also used data from other sources, including:

- American Public Transportation Association (APTA). A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys, May 2007
- CJI Research Corporation (2017), Who Rides Public Transportation, American Public Transportation Association (APTA)
- U.S. DOT, FHWA, Summary of Travel Trends: 2017 National Household Travel Survey (July 2018).
- Public Use Microdata Sample (PUMS)
- Bureau of Labor Statistics (BLS), Occupational Employment Statistics (OES) for the Commonwealth of Virginia
- Running emission rates for autos, buses, passenger train and light rail provided by Caltrans, California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C) 6.2, December 2017
- CO2 per passenger-mile by transit mode provided by CITYLAB
- U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, December 2018
- Fuel Consumption Rates for autos provided by Caltrans, California Life-Cycle Benefit/Cost Analysis Model (Cal-B/C) 6.2, December 2017
- Fuel Prices provided by the U.S. Energy Information Administration (EIA), Petroleum Administration for Defense Districts 1 (PADD1) based on all gas grades
- American Automobile Association (AAA). Your Driving Costs, 2018 Edition

- Historical fatality rates for Virginia and area (urban and rural) obtained from the Fatality Analysis Reporting System (FARS)
- Historical people injured in traffic crashes by severity (fatality, serious injury, minor injury and possible injury) and area (urban and rural) obtained from Virginia Department of Transportation (VDOT) Tableau Crash Tool
- Marginal Pavement Maintenance Cost per VMT for private passenger cars and buses from the U.S. Department of Transportation (US DOT), Federal Highway Administration (FHWA)

Enterprise Data

» In FY2018, transit agencies in the Commonwealth of Virginia employed over 7,000 people and paid $578.7M in wages and fringe benefits (

Table 3-4). Since information on the exact number of employees was not available for all 41 transit agencies in the state, the total number of employees in the state was estimated as follows:

- The average annual salary per employee for the transit agencies based in Virginia was estimated using data for 25 transit agencies that was available. The total payroll spending divided by the total number of employees[8] based on data provided by these 25 transit agencies yields an average annual salary per employee of $52,199 per year.

- The numbers of employee for the 40 transit agencies based in Virginia was estimated by dividing the total payroll spending ($185,126,885) by the average annual salary per employee ($52,199). This yielded 3,547 employees.

- The number of employees of contractors supporting the transit agencies in Virginia was estimated using a proportional assumption to divide total payroll spending ($49,908,507) by the expected annual salary per employee of $100,000 (See Table 3-4, Note 4 for an explanation of how contractor payroll spending was estimated) which yielded 499 employees.

- The number of WMATA employees supporting transit services in Virginia was estimated by dividing WMATA payroll spending ($343,699,271) by WMATA personnel cost per employee systemwide[9] ($115,321). This step yielded 2,980 employees.

- The total number of direct jobs generated by transit agencies in the Commonwealth of Virginia is 7,025, including agency employees and contractors.

[8] Number of employees in FY2018 for the 25 transit agencies based in Virginia come from their FY2018 CAFRs and file “Grantees.xlxs” provided by DRPT.

[9] Washington Metropolitan Area Transit Authority, FY2018 Approved Budget; U.S. Government Accountability Office (GAO), Report to Congressional Requesters, Washington Metropolitan Area Transit Authority, Assessing Fiscal Risk and Improving Workforce Management Would Help Achieve Strategic Goals, September 2018.

Table 3-4 Employee Compensation (Wages and Benefits) by Transit Agency, FY2018

	Transit Agency	Payroll Spending (2018$)
1	Alexandria Transit Company	$13,204,928
2	Altavista Community Transit System (ACTS)	$74,409
3	Arlington County Transit (ART)	$552,947
4	Bay Transit	$1,908,259
5	Blacksburg Transit	$5,676,697
6	Blackstone Area Bus System (BABS)	$191,419
7	Bristol Virginia Transit	$350,306
8	Central Shenandoah Planning District Commission (BRITE)	$145,610
9	Charlottesville Area Transit (CAT)	$5,954,402
10	Chincoteague Pony Express	$48,549
11	City of Fairfax (CUE)	$1,673,349
12	Danville Transit	$1,478,881
13	District Three Public Transit (Mountain Lynx)	$1,386,698
14	Fairfax County (Fairfax Connector)*	$12,092,445
15	Farmville Area Bus (FAB)	$545,679
16	Four County Transit	$1,156,991
17	Fredericksburg Regional Transit (FRED)	$2,531,838
18	Graham Transit	$253,597
19	Greater Lynchburg Transit Company (GLTC)	$5,523,012
20	Greater Richmond Transit Company (GRTC)	$30,225,129
21	Greater Roanoke Transit Company (Valley Metro)	$5,659,813
22	Greene County Transit	$735,114
23	Greensville-Emporia Transit	$105,048
24	Hampton Roads Transit (HRT)	$62,807,125
25	Harrisonburg Department of Public Transportation (HDPT)	$2,864,217
26	JAUNT	$4,829,556
27	Lake Country Area Agency on Aging	$83,773
28	Loudoun County (LC Transit)	$537,307
29	Mountain Empire Older Citizens (MEOC)	$958,887
30	Petersburg Area Transit (PAT)	$2,344,829
31	Potomac and Rappahannock Transportation Commission (PRTC) (Omniride, OmniLink)	$4,667,233
32	Pulaski Area Transit (PAT)	$438,780
33	RADAR	$828,425
34	Radford Transit	$47,915
35	STAR Transit	$398,526
36	Suffolk Transit	$41,236
37	Virginia Railway Express (VRE)	$7,091,742
38	Virginia Regional Transit (VRT)	$1,836,171
39	Winchester (WinTran)	$734,831
40	Williamsburg Area Transit (WATA)	$3,141,212
	Sub-Total = (a)	**$185,126,885**
41	Washington Metropolitan Area Transit Authority (WMATA) = (b)	$343,699,271 (FY2017)
	Contractors = (c)	$49,908,507
	Grand Total = (a) + (b) + (c)	**$578,734,662**

Notes (Table 3-4):

1. Salaries and benefits spending in FY2018 for 39 transit agencies based in Virginia come from their *Operating Assistance Applications* provided by DRPT.
2. *Salaries and benefits spending for Fairfax County (Fairfax Connector) in FY2018 was not itemized in its *Operating Assistance Applications* provided by DRPT. Since the combined Fairfax County payroll and non-payroll spending is of the same order of magnitude of the combined VRE payroll and non-payroll spending, this analysis assumes the share of Fairfax County payroll expenses is similar to the share of VRE payroll expenses.
3. Salaries and benefits spending in FY2017 for WMATA came from its *Operating Assistance Applications* provided by DRPT. Since this is the latest fiscal year this information is available, this analysis assumed that this value also represents WMATA salaries and benefits spending in FY2018.
4. The “Contracted Paratransit”, “Contracted Repair & Maintenance” and “Purchased Transportation Services” expenses reported in the *Operating Assistance Applications* files provided by DRPT included salaries and benefits of employees supported by VA transit agencies contracts. To estimate Contractors payroll spending, a two-step process was applied. First, the “Contracted Paratransit”, “Contracted Repair & Maintenance” and “Purchased Transportation Services” expenses were subtracted from the total non-payroll expenses. Second, the total payroll spending was divided by the outcome of the previous step. This yields the payroll shares of 30 percent, 32 percent and 31 percent of the “Contracted Paratransit”, “Contracted Repair & Maintenance”, and “Purchased Transportation Services” expenses.
5. N/A means that the information is not available in the reviewed sources.

In FY2018, transit agencies in the Commonwealth of Virginia spent nearly $1.7B in non-payroll, operating expenses and $483M in capital expenses (

Table 3-5). These expense categories included the following items:

- Capital expenditures include, but are not limited to spending on: paratransit van replacement/expansion, bus replacement/expansion, bus shelters, surveillance/security equipment, building construction/maintenance, facility upgrades, rebranding, support vehicles, parking infrastructure construction, engineering and design, rail car rehabilitation, technology infrastructure, lease buses, bus stop signs, building leases, contractor project management/engineering.

- Non-payroll operating expenditures include, but are not limited to: office supplies and materials, travel, postage, utilities, printing and reproduction, advertising and promotion, equipment maintenance, insurance, professional fees, drivers' physicals, accident maintenance, fuel, fiscal agent services, telecommunications, clothing, marketing and sales, contract services, non-contract operations and maintenance, general and administrative, internal goods and services, education and training, cleaning supplies, motor fuels and lubricants, tires and tubes, parts, drug testing supplies, service and maintenance contracts, tools and machinery, communication services, and office expenses, among others.

Table 3-5 Capital and Non-Payroll Expenses by Transit Agency, FY2018

	Transit Agency	Non-Payroll Expenses (2018$)	Capital Expenses (2018$)
1	Alexandria Transit Company	$8,159,028	$4,150,000
2	Altavista Community Transit System (ACTS)	$56,745	$64,000
3	Arlington County Transit (ART)	$14,270,073	$13,951,939
4	Bay Transit	$1,668,353	$738,132
5	Blacksburg Transit	$6,127,482	$7,449,172
6	Blackstone Area Bus System (BABS)	$287,060	$145,000
7	Bristol Virginia Transit	$99,105	$60,000
8	Central Shenandoah Planning District Commission (BRITE)	$1,768,465	$764,425
9	Charlottesville Area Transit (CAT)	$4,813,412	$649,570
10	Chincoteague Pony Express	$66,050	$0
11	City of Fairfax (CUE)	$1,030,563	$23,000
12	Danville Transit	$1,656,953	$959,550
13	District Three Public Transit (Mountain Lynx)	$1,014,922	$425,680
14	Fairfax County (Fairfax Connector)*	$72,194,183	$48,960,000
15	Farmville Area Bus (FAB)	$308,737	$473,300
16	Four County Transit	$475,505	$612,418
17	Fredericksburg Regional Transit (FRED)	$2,540,015	$203,000
18	Graham Transit	$136,645	$130,000
19	Greater Lynchburg Transit Company (GLTC)	$6,058,685	$540,309
20	Greater Richmond Transit Company (GRTC)	$16,094,532	$25,757,469
21	Greater Roanoke Transit Company (Valley Metro)	$5,096,346	$180,000
22	Greene County Transit	$271,870	$120,000
23	Greensville-Emporia Transit	$53,919	$254,975
24	Hampton Roads Transit (HRT)	$60,101,255	$23,645,056
25	Harrisonburg Department of Public Transportation (HDPT)	$3,426,930	$920,000
26	JAUNT	$2,904,795	$3,385,891
27	Lake Country Area Agency on Aging	$150,308	$40,000
28	Loudoun County (LC Transit)	$18,311,781	$4,065,351
29	Mountain Empire Older Citizens (MEOC)	$1,225,844	$554,620
30	Petersburg Area Transit (PAT)	$2,351,496	$608,000
31	Potomac and Rappahannock Transportation Commission (PRTC) (Omniride, OmniLink)	$37,974,730	$21,753,908
32	Pulaski Area Transit (PAT)	$760,539	$141,000
33	RADAR	$1,215,665	$190,000
34	Radford Transit	$1,639,147	$0
35	STAR Transit	$512,953	$248,000
36	Suffolk Transit	$678,378	$303,000
37	Virginia Railway Express (VRE)	$81,871,036	$58,940,808
38	Virginia Regional Transit (VRT)	$5,118,252	$445,000
39	Winchester (WinTran)	$493,979	$275,000
40	Williamsburg Area Transit (WATA)	$5,261,662	$1,436,709
	Sub-Total = (a)	**$368,247,400**	**$223,564,282**
41	Washington Metropolitan Area Transit Authority (WMATA) = (b)	$117,812,672 (FY2017)	$259,622,256
	Grand Total = (a) + (b)	**$486,060,072**	**$483,186,538**

Notes:

1. Non-Payroll operating expenses in FY2018 for the 40 transit agencies based in Virginia came from the *Operating Assistance Applications* files provided by DRPT.
2. *Non-Payroll spending for Fairfax County (Fairfax Connector) in FY2018 was not itemized between payroll and non-payroll expenses in the *Operating Assistance Applications* files provided by DRPT. Since the combined Fairfax County payroll and non-payroll spending is of the same order of magnitude of the combined VRE payroll and non-payroll spending, this analysis assumes the share

of Fairfax County operating (non-payroll) expenses is similar to the share of VRE operating (non-payroll) expenses.

3. Non-Payroll expenses in FY2017 for WMATA comes from its *Operating Assistance Applications* provided by DRPT. Since this is the latest fiscal year this information is available, this analysis assumes that this value also represents WMATA operating expenses in FY2018.
4. Capital expenses in FY2018 come from the file "FY18 Final SYIP June", 'Construction District Detail' tab, provided by DRPT. These data represent actual capital allocations.

Transit Data

Table 3-6 presents transit ridership, vehicle revenue miles (VRM), vehicle revenue hours (VRH), passenger miles traveled (PMT), average trip length (in miles), average transit vehicle speed and estimated passenger hours traveled (PHT) by transit agency in FY2018. This data was used to estimate the direct economic benefits generated by transit services.

Table 3-7 shows the alternative transportation modes that riders would use and the number of trips that would be forgone if transit were not available in Virginia. This analysis used national mode shift factor values provided by the Federal Transit Administration (FTA) and the American Public Transportation Association (APTA).[10] The values in **Table 3-7** were used to estimate additional vehicle miles traveled (VMT) and transportation costs that would-be transit riders would incur by being forced to use alternative motorized modes ('drive alone', 'ride with someone', and 'taxi/ride-hailing') in the absence of transit. These values were also used to estimate how many trips would be forgone entirely ('trip not made'). Since some transit riders relied on transit as their only means to travel to work, this study also estimated the value of lost wages associated with transit riders that could not get to work if transit services were not available.

Table 3-8 shows the distribution of transit riders by income in Virginia, as provided in the Transit Development Plans (TDPs) adopted by each agency. Since these data were incomplete, this analysis used national values on household incomes of transit riders reported by the American Public Transportation Association (APTA) to fill in the gaps. According with APTA[11], in 2004, 20.1 percent of transit riders reported household incomes of less than $15,000; 45.6 percent reported household incomes from $15,000 to $49,999; 24.8 percent reported household incomes from $50,000 to $99,000; and 9.5 percent reported household incomes of $100,000 or more. **Table 3-9** shows the estimated distribution of transit trips by income based on state and national values used in this analysis.

Table **3-10** shows the average transit fares per trip for each of the 41 transit agencies in Virginia.

Table **3-11** shows the average parking costs in Virginia urban areas served by transit.

[10] *Transit Performance Monitoring System (TPMS) Results*, Phases I and II (2002) and Phase III (2004). Prepared for the American Public Transportation Association (APTA) and the Federal Transit Administration (FTA) by McCollom Management Consulting.

[11] APTA, A Profile of Public Transportation Passenger Demographics and Travel Characteristics Reported in On-Board Surveys, May 2007.

Table 3-6 Virginia Transit Ridership, VRH, VRM, PMT, PHT, and Average Trip Length, FY2018

Rank	Transit Agency	FY2018 Ridership	FY2018 VRH	FY2018 VRM	Estimated PMT in FY2018	Average Trip Length (miles)	Transit Vehicle Speed (VRM/VRH)	Estimated PHT in FY2018
1	Hampton Roads Transit	13,761,674	1,085,917	14,452,615	76,512,171	5.6	13.3	5,748,847
2	Fairfax County	8,312,983	751,540	9,921,704	40,994,187	4.9	13.2	3,105,189
3	Greater Richmond Transit Company (GRTC)	7,723,202	549,136	6,831,089	62,915,518	8.1	12.4	5,057,638
4	Virginia Railway Express (VRE)	4,631,909	78,377	2,416,320	142,112,395	30.7	30.8	4,609,631
5	Blacksburg Transit	4,057,334	105,575	1,039,319	6,972,792	1.7	9.8	708,303
6	City of Alexandria Office of Transit Services and Programs	3,942,608	240,770	2,184,444	7,650,397	1.9	9.1	843,229
7	Arlington County	3,084,105	222,424	2,250,919	6,896,087	2.2	10.1	681,435
8	PRTC	2,408,052	232,792	4,856,263	100,140,031	41.6	20.9	4,800,367
9	Greater Lynchburg Transit Company	2,325,667	105,441	1,261,330	7,277,892	3.1	12.0	608,396
10	Williamsburg Area Transit Authority	2,253,353	94,173	1,354,955	5,629,815	2.5	14.4	391,287
11	City of Harrisonburg Dept. of Public Transportation	2,116,785	77,394	760,696	4,522,831	2.1	9.8	460,158
12	Greater Roanoke Transit Company	2,071,948	153,595	2,445,997	12,808,178	6.2	15.9	804,282
13	Charlottesville Area Transit	2,052,376	103,824	962,806	9,374,307	4.6	9.3	1,010,877
14	Loudoun County Office of Transportation Services	1,696,062	184,352	4,446,337	41,292,224	24.3	24.1	1,712,040
15	City of Fairfax	605,388	33,576	439,834	2,052,265	3.4	13.1	156,666
16	City of Petersburg	342,730	59,574	642,570	1,565,433	4.6	10.8	145,135
17	City of Radford	328,929	31,419	342,734	1,502,396	4.6	10.9	137,727
18	FRED	324,780	51,340	824,087	1,483,445	4.6	16.1	92,418
19	Danville Transit System	322,259	36,176	562,324	1,471,931	4.6	15.5	94,694
20	Central Shenandoah PDC	267,323	30,716	594,906	1,221,008	4.6	19.4	63,043
21	JAUNT	242,538	85,534	1,421,169	3,138,891	12.9	16.6	188,916
22	VRT	233,284	48,062	932,639	1,065,534	4.6	19.4	54,911
23	District Three Public Transit	166,883	48,449	494,447	762,245	4.6	10.2	74,689
24	Farmville Area Bus	157,818	14,537	219,837	720,840	4.6	15.1	47,666
25	AASC / Four County Transit	150,004	35,429	751,233	685,149	4.6	21.2	32,312
26	Pulaski Area Transit	147,447	19,909	274,467	673,470	4.6	13.8	48,851
27	Bay Aging	141,335	61,906	1,398,610	645,553	4.6	22.6	28,574
28	City of Winchester	140,002	18,081	193,905	639,465	4.6	10.7	59,628
29	City of Suffolk	111,906	14,618	258,519	511,135	4.6	17.7	28,902
30	RADAR	105,729	49,946	745,572	482,921	4.6	14.9	32,351
31	Mountain Empire Older Citizens, Inc.	100,058	53,717	897,299	457,019	4.6	16.7	27,360
32	STAR Transit	97,201	19,349	496,482	443,969	4.6	25.7	17,302
33	Greene County Transit, Inc.	63,081	21,594	348,660	288,125	4.6	16.1	17,845
34	City of Bristol Virginia	53,158	7,370	89,608	242,801	4.6	12.2	19,970

Rank	Transit Agency	FY2018 Ridership	FY2018 VRH	FY2018 VRM	Estimated PMT in FY2018	Average Trip Length (miles)	Transit Vehicle Speed (VRM/VRH)	Estimated PHT in FY2018
35	Town of Bluefield-Graham Transit	42,374	7,814	129,996	193,545	4.6	16.6	11,634
36	Blackstone Area Bus	36,138	14,480	386,613	165,062	4.6	26.7	6,182
37	Town of Altavista	19,584	3,021	47,993	89,451	4.6	15.9	5,631
38	Lake Area	12,739	5,137	60,428	58,186	4.6	11.8	4,946
39	Town of Chincoteague	11,873	1,350	14,689	54,230	4.6	10.9	4,984
40	Greensville County	3,946	2,658	37,909	18,024	4.6	14.3	1,264
	Sub-Total	**64,666,565**	**4,761,073**	**67,791,324**	**545,730,916**			**31,945,279**
41	Washington Metropolitan Area Transit Authority (WMATA)	108,748,851	2,060,020	41,881,399	589,239,256	5.4	20.3	28,982,901
	Grand Total =	**173,415,416**	**6,821,092**	**109,672,724**	**1,134,970,172**			**60,928,180**

Notes:

1. Ridership, VRM, and VRH for the 40 transit agencies in Virginia are collected directly from each agency and verified by DRPT annually. These figures were included in the “DRPT EIT – FY18 transit data sheet for CS.xlxs” file provided by DRPT.
2. PMT measures for the following agencies came from the National Transit Database (NTD): Hampton Roads Transit, Fairfax County, GRTC, VRE, Blacksburg Transit, City of Alexandria, Arlington County, PRTC, Greater Lynchburg Transit Company, Williamsburg Area Transit Authority, City of Harrisonburg, Greater Roanoke Transit Company, Loudoun County, City of Fairfax, and JAUNT. FY18 PMT was extrapolated from agency-reported FY17 PMT to NTD using the change in ridership from FY17 to FY18.
3. Estimated PMT for other agencies was calculated by using the average trip distance of all NTD PMT reporters (PMT/UPT). Before running this calculation three outliers were removed -- VRE, PRTC, and Loudon County due to the commuter nature of their services. The result was an average of 4.57 miles travelled per UPT. The 4.57 figure was multiplied by the FY18 UPT for the smaller agencies to estimate their FY18 PMT
4. WMATA ridership came from the Report of the Secretary of Transportation "How the Commonwealth is Using Transit and Transportation Demand Management to Reduce Congestion and Use of Single-Occupant Vehicles" to the General Assembly of Virginia (Commonwealth of Virginia, Richmond, 2018).
5. WMATA PMT, VRM and VRH in FY2018 were estimated based o FY2017 WMATA stats as follows: FY2018 PMT = FY2018 Ridership (or Unlinked Trips) x FY2017 miles per trip; FY2018 VRM = FY2018 PMT x [FY2017 VRM / FY2017 PMT]; and FY2018 VRH = FY2018 PMT x [FY2017 VRH / FY2017 PMT].
6. The values reported in this table do not include vanpool transportation or the special transportation services for seniors and individuals with disabilities funded by the FTA Section 5310 program that are provided by human service providers.

Table 3-7 Mode Shift Factors

Service Area Size	Population Served	Drive Alone (a)	Walk (b)	Ride with Someone (c)	Taxi (d)	Bicycle (e)	Not Make Trip (f)
Small	<500,000	12.8%	26.8%	22.8%	11.7%	4.5%	21.5%
Medium	500,000 to 1,250,000	21.1%	22.0%	20.0%	13.1%	5.1%	18.7%
Large	>1,250,000	24.9%	7.0%	33.1%	8.7%	1.1%	25.2%

Notes:

1. Data Source: *Transit Performance Monitoring System (TPMS) Results*, Phases I and II (2002) and Phase III (2004), prepared by McCollom Management Consulting for the American Public Transportation Association (APTA) and the Federal Transit Administration (FTA).
2. Average vehicle occupancy for 'ride with someone' is assumed to be 2.5, based on a mix of two- and three-person per vehicle.
3. The values in this table were intended to capture anticipated modal shift as well as forgone trips in a hypothetical situation that imagines the state and the study areas without transit.

Table 3-8 Distribution of Virginia Transit Riders by Income

	Transit Agency	Income ≤ $20K	20K < Income ≤ 35K	35K < Income ≤ 50K	50K < Income ≤ 75K	75K < Income ≤ 100K	Income > $100 K	Did not answer or Did not Know
4	Bay Transit	40.0%	N/A	N/A	N/A	N/A	N/A	60.0%
5	Blacksburg Transit	43.0%	N/A	N/A	N/A	N/A	N/A	57.0%
7	Bristol Virginia Transit	53.0%	5.0%	8.0%	1.0%	N/A	N/A	33.0%
9	Charlottesville Area Transit (CAT)	43.2%	23.6%	N/A	N/A	N/A	N/A	33.2%
16	Four County Transit	92.0%	N/A	N/A	N/A	N/A	N/A	8.0%
17	Fredericksburg Regional Transit (FRED)	45.0%	24.0%	N/A	N/A	N/A	N/A	31.0%
18	Graham Transit	69.6%	N/A	N/A	N/A	N/A	N/A	30.4%
19	Greater Lynchburg Transit Company (GLTC)	75.0%	N/A	N/A	N/A	N/A	N/A	25.0%
24	Hampton Roads Transit (HRT)	66.0%	14.0%	10.0%	6.0%	1.0%	1.0%	2.0%
28	Loudoun County (LC Transit)	50.0%	N/A	N/A	N/A	N/A	N/A	50.0%
30	Petersburg Area Transit (PAT)	46.0%	33.0%	N/A	N/A	N/A	N/A	21.0%
32	Pulaski Area Transit (PAT)	89.0%	N/A	N/A	N/A	N/A	N/A	11.0%
34	Radford Transit	45.0%	17.0%	N/A	N/A	N/A	N/A	38.0%
35	STAR Transit	60.0%	33.0%	N/A	N/A	N/A	N/A	7.0%
36	Suffolk Transit	54.0%	40.0%	N/A	N/A	N/A	N/A	6.0%
37	Virginia Railway Express (VRE)	N/A	N/A	N/A	N/A	88.0%	N/A	12.0%
40	Williamsburg Area Transit (WATA)	38.0%	28.0%	N/A	N/A	N/A	N/A	34.0%
41	Washington Metropolitan Area Transit Authority (WMATA)	4.2%	2.1%	8.3%	10.4%	14.6%	50.0%	10.4%

Notes:

1. This table shows the distribution of transit riders by income provided in the Transit Development Plans (TDPs) of transit agencies based in Virginia. N/A means that these data are not reported in the reviewed TDPs. The transit agencies that are not listed in this table is because this information is not available in their TDPs.
2. Distribution of WMATA riders by income estimated based on the income levels of Metrorail riders provided by the *2016 Metrorail Passenger Survey Analysis* (NVTC, October 2017).
3. Given the data gaps on the distribution of transit riders by income, this analysis used national average to estimate the missing values.

Table 3-9 Estimated Distribution of Virginia Transit Riders by Income

	Transit Agency	Income ≤ $20K	20K < Income ≤ 65K	65K < Income ≤ 130K	Income > $130 K	Total
1	Alexandria Transit Company	20.1%	45.6%	24.8%	9.5%	100.0%
2	Altavista Community Transit System (ACTS)	20.1%	45.6%	24.8%	9.5%	100.0%
3	Arlington County Transit (ART)	20.1%	45.6%	24.8%	9.5%	100.0%
4	Bay Transit	40.0%	34.2%	18.6%	7.1%	100.0%
5	Blacksburg Transit	43.0%	32.5%	17.7%	6.8%	100.0%
6	Blackstone Area Bus System (BABS)	20.1%	45.6%	24.8%	9.5%	100.0%
7	Bristol Virginia Transit	53.0%	26.8%	14.6%	5.6%	100.0%
8	Central Shenandoah Planning District Commission (BRITE)	20.1%	45.6%	24.8%	9.5%	100.0%
9	Charlottesville Area Transit (CAT)	43.2%	32.4%	17.6%	6.8%	100.0%
10	Chincoteague Pony Express	20.1%	45.6%	24.8%	9.5%	100.0%
11	City of Fairfax (CUE)	20.1%	45.6%	24.8%	9.5%	100.0%
12	Danville Transit	20.1%	45.6%	24.8%	9.5%	100.0%
13	District Three Public Transit (Mountain Lynx)	20.1%	45.6%	24.8%	9.5%	100.0%
14	Fairfax County (Fairfax Connector)	20.1%	45.6%	24.8%	9.5%	100.0%
15	Farmville Area Bus (FAB)	20.1%	45.6%	24.8%	9.5%	100.0%
16	Four County Transit	92.0%	4.6%	2.5%	1.0%	100.0%
17	Fredericksburg Regional Transit (FRED)	45.0%	31.4%	17.1%	6.5%	100.0%
18	Graham Transit	69.6%	17.3%	9.4%	3.6%	100.0%
19	Greater Lynchburg Transit Company (GLTC)	75.0%	14.3%	7.8%	3.0%	100.0%
20	Greater Richmond Transit Company (GRTC)	20.1%	45.6%	24.8%	9.5%	100.0%
21	Greater Roanoke Transit Company (Valley Metro)	20.1%	45.6%	24.8%	9.5%	100.0%
22	Greene County Transit	20.1%	45.6%	24.8%	9.5%	100.0%
23	Greensville-Emporia Transit	20.1%	45.6%	24.8%	9.5%	100.0%
24	Hampton Roads Transit (HRT)	66.0%	19.4%	10.6%	4.0%	100.0%
25	Harrisonburg Department of Public Transportation (HDPT)	20.1%	45.6%	24.8%	9.5%	100.0%
26	JAUNT	20.1%	45.6%	24.8%	9.5%	100.0%
27	Lake Country Area Agency on Aging	20.1%	45.6%	24.8%	9.5%	100.0%
28	Loudoun County (LC Transit)	50.0%	28.5%	15.5%	5.9%	100.0%
29	Mountain Empire Older Citizens (MEOC)	20.1%	45.6%	24.8%	9.5%	100.0%

	Transit Agency	Income ≤ $20K	20K < Income ≤ 65K	65K < Income ≤ 130K	Income > $130 K	Total
30	Petersburg Area Transit (PAT)	46.0%	30.8%	16.8%	6.4%	100.0%
31	Potomac and Rappahannock Transportation Commission (PRTC) (Omniride, OmniLink)	20.1%	45.6%	24.8%	9.5%	100.0%
32	Pulaski Area Transit (PAT)	89.0%	6.3%	3.4%	1.3%	100.0%
33	RADAR	20.1%	45.6%	24.8%	9.5%	100.0%
34	Radford Transit	45.0%	31.4%	17.1%	6.5%	100.0%
35	STAR Transit	60.0%	22.8%	12.4%	4.8%	100.0%
36	Suffolk Transit	54.0%	26.3%	14.3%	5.5%	100.0%
37	Virginia Railway Express (VRE)	20.1%	45.6%	24.8%	9.5%	100.0%
38	Virginia Regional Transit (VRT)	20.1%	45.6%	24.8%	9.5%	100.0%
39	Winchester (WinTran)	20.1%	45.6%	24.8%	9.5%	100.0%
40	Williamsburg Area Transit (WATA)	38.0%	35.4%	19.2%	7.4%	100.0%
41	Washington Metropolitan Area Transit Authority (WMATA)	4.2%	54.7%	29.7%	11.4%	100.0%

Table 3-10 Average Transit Fares per Trip in Virginia

	Transit Agency	Ridership	Fares Revenue (2018$)	Average Transit Fare per Unlinked Trip (2018$)
1	Hampton Roads Transit	13,761,674	16,369,591	$1.19
2	Fairfax County	8,312,983	10,707,592	$1.29
3	Greater Richmond Transit Company (GRTC)	7,723,202	9,907,245	$1.28
4	Virginia Railway Express (VRE)	4,631,909	43,313,365	$9.35
5	Blacksburg Transit	4,057,334	1,986,924	$0.49
6	City of Alexandria Office of Transit Services and Programs	3,942,608	3,756,251	$0.95
7	Arlington County	3,084,105	4,661,372	$1.51
8	PRTC	3,862,646	21,829,645	$5.65
9	Greater Lynchburg Transit Company	2,325,667	3,152,718	$1.36
10	Williamsburg Area Transit Authority	2,253,353	917,151	$0.41
11	City of Harrisonburg Dept. of Public Transportation	2,116,785	1,864,586	$0.88
12	Greater Roanoke Transit Company	2,210,965	2,093,484	$0.95
13	Charlottesville Area Transit	2,189,612	468,563	$0.21
14	Loudoun County Office of Transportation Services	1,696,062	9,817,508	$5.79
15	City of Fairfax	605,388	1,251,410	$2.07
16	City of Petersburg	532,004	435,459	$0.82
17	City of Radford	338,719	516,152	$1.52
18	FRED	377,042	315,092	$0.84
19	Danville Transit System	359,149	330,770	$0.92
20	Central Shenandoah PDC	220,832	67,226	$0.30
21	JAUNT	322,822	1,116,857	$3.46
22	VRT – NOVA Loudoun, Virginia	32,287	29,736	$0.92
22	VRT – Culpeper, Virginia	138,156	37,339	$0.27
22	VRT – Staunton, Virginia	81,693	21,837	$0.27
23	District Three Public Transit	162,030	64,859	$0.40
24	Farmville Area Bus	136,330	11,065	$0.08
25	AASC / Four County Transit	159,527	17,305	$0.11
26	Pulaski Area Transit	139,840	103,204	$0.74
27	Bay Aging	147,176	158,844	$1.08
28	City of Winchester	143,208	91,192	$0.64
29	City of Suffolk	115,001	77,927	$0.68
30	RADAR	69,606	43,325	$0.62
31	Mountain Empire Older Citizens, Inc.	83,707	49,565	$0.59
32	STAR Transit	93,787	46,883	$0.50
33	Greene County Transit, Inc.	64,238	51,675	$0.80
34	City of Bristol Virginia	55,140	46,229	$0.84
35	Town of Bluefield-Graham Transit	40,949	10,489	$0.26
36	Blackstone Area Bus	38,127	21,391	$0.56
37	Town of Altavista	22,759	3,563	$0.16
38	Lake Area	12,585	19,622	$1.56
39	Town of Chincoteague	13,884	7,156	$0.52
40	Greensville County	n/a	-	$1.00
41	Washington Metropolitan Area Transit Authority (WMATA)	352,545,938	676,675,105	$1.92

Notes: Average fares based on 2017 National Transit Database (adjusted to FY18 dollars)

Table 3-11 Average Parking Costs in Virginia Urban Areas Served by Transit

Transit Agency	Urban Areas	Average Parking Cost in Urban Areas ($/hour)	Daily Maximum Parking Cost in Urban Areas ($/day)
Alexandria Transit Company	Alexandria	$4.65	$12.55
Arlington County Transit (ART)	Arlington	$1.75	N/A
Blacksburg Transit	Blacksburg	$1.00	N/A
Central Shenandoah Planning District Commission (BRITE)	Staunton	$1.25	$7.50
Charlottesville Area Transit (CAT)	Charlottesville	$2.00	$12.00
Greater Lynchburg Transit Company (GLTC)	Lynchburg	$1.00	$5.00
Greater Richmond Transit Company (GRTC)	Richmond	$3.50	$13.50
Greater Roanoke Transit Company (Valley Metro)	Roanoke	$2.00	$8.00
Hampton Roads Transit (HRT)	Norfolk, Portsmouth, and Virginia Beach	$1.38	$9.43
JAUNT	Charlottesville	$2.00	$12.00
Loudoun County (LC Transit)	Leesburg	$1.50	N/A
RADAR	Roanoke	$2.00	$8.00
Winchester (WinTran)	Winchester	$0.75	N/A
Williamsburg Area Transit (WATA)	Williamsburg	$0.50	$6.00
Washington Metropolitan Area Transit Authority (WMATA)	Alexandria, Arlington, Fairfax County, Fairfax City, Falls Church, and Loudoun	$1.00	N/A

Notes:

1. This table shows the average parking cost (per hour or daily maximum) in Virginia's urban areas served by transit obtained from city government websites (Alexandria, Arlington, Blacksburg, Charlottesville, Leesburg, Lynchburg, Norfolk, Portsmouth, Richmond, Roanoke, Staunton, Virginia Beach, Williamsburg, Winchester) and WMATA
2. N/A means that the information is not available in the reviewed sources.

Auto Data

In 2018, the reported daily VMT on Virginia roadways was 233.79M, and the annual VMT was 85.3B (**Table 3-12**). Daily passenger car VMT, VHT, and travel speeds by trip purpose in 2018 are shown in

Table 3-13. These values are estimated by using the outputs from Virginia Travel Demand Model (TDM) runs for 2015 and 2025 and assuming a linear growth between 2015 and 2025 to arrive at a 2018 estimate.

Table 3-12 Reported Daily and Annual Auto VMT by Roadway Functional Class, 2018

Statewide	Daily VMT	Annual VMT (M)
Interstate	72,478,749	26,457
Primary	97,061,166	25,282
Secondary	64,250,525	33,597
Total =	233,790,440	85,336

Note:

1. Data Source: VDOT, 2018 Traffic Data Daily Vehicle Miles Traveled; U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), table VM-202, available at http://www.fhwa.dot.gov/policyinformation/statistics.cfm as of Dec. 3, 2019.

Table 3-13 Estimated Daily Auto VMT, VHT, and Travel Speeds by Trip Purpose, 2018 (Travel Demand Model)

	Statewide			
	Commute (Work) Trips	**Business Trips**	**"All Other Purpose" Trips**	**Total**
Daily VMT	51,335,305	17,645,840	180,867,580	249,848,725
Daily VHT	1,869,120	411,328	5,562,732	7,843,180
Travel Speed (mph)	27.5	42.9	32.5	31.9

Notes:

1. Data source: Virginia Travel Demand Model (TDM) outputs (VMT and VHT) in 2015 and 2025.
2. Auto VMT and VHT in 2018 was estimated assuming VMT and VHT would grow linearly between 2015 and 2025.
3. Average travel speeds are estimated as passenger car VMT divided by passenger car VHT

4.0 Enterprise Spending

The enterprise spending of the agencies operating transit services in Virginia reverberates through the state's economy each year. Through this direct payroll, non-payroll, and capital spending, each agency generates economic activity by creating jobs and spurring purchases of goods and services. In FY2018, transit agencies throughout the state spent over $1.5B on capital and operating expenses. Without transit agencies in Virginia, these expenditures would not occur and therefore not benefit the state economy.

4.1 Payroll Expenditures

The IMPLAN economic model was used to measure the economic impact of current employment compensation (wages and benefits) associated with transit employees. Transit agencies spent $579M to support the wages and fringe benefits of over 7,000 employees, The total fully burdened compensation of employees, shown in

Table 3-4, is input into the IMPLAN model as a change in 'Industry Employment Compensation' in the transit passenger transportation sector. This was used to estimate the total (direct, indirect, and induced) economic impact of payroll spending on full-time jobs, personal income, value added (Gross State Product or GSP), and tax revenue collected statewide as well as from the study's specific sub-areas: NoVA, Other Urban Areas, and Rural Areas (with transit services).

4.2 Capital and Non-Payroll Operating Expenditures

Capital and non-payroll operating expenditures were allocated to the selected IMPLAN industry sectors according to expenditure breakdowns provided by DRPT illustrating how each agency spent these funds in FY2018. To take into account that some capital and operating expenditures occurred within the state while others occurred outside of Virginia, this analysis estimated location quotients (LQs) for the selected industry sectors to identify export and import industries in the state. Export industries included those that produced more of a good or service than is needed to meet the state demand, whereas import industries included those producing less than enough to meet area demand.

Location quotients were used to measure relative industrial concentration within a specific local geographic or economic area (e.g., the state) in comparison to a broader base geographic or economic area (e.g., the U.S.). This measure was calculated as the ratio of an industry's share of the Virginia economy to the respective industry's share of the U.S. economy, based on the "value added" of the selected industries at the state and national level available from IMPLAN. This analysis used location quotients as follows:

- Industries with a location quotient greater than 1.00 are those industries that were relatively more concentrated in the local geographic area (the state) than in the base (the nation). Local production of goods and services by these industries generally exceeded the local demand, assuming that the demand for the goods and services of that industry in proportion to the entire economy are the same at both the local and base geographic areas. This allowed the excess production to be exported from the local economy (the state) to the broader base economic area (the nation).

- Industries with a small location quotient were those industries that were not concentrated in the local geographic area (the state) relative to the base (the nation) and, therefore, the local economy was likely a net importer of the goods and services of those industries from the broader base economy.

- Industries with a location quotient equal or close to one, were those that are similarly concentrated within the local geographic area (the state) and the base (the nation).

Capital and non-payroll operating expenditures were apportioned to Virginia based on the allocation factors shown in **Table 4-1**. This included a total of $288M in non-payroll operating expenses and $454.8M in capital expenses. The expenditure breakdowns were allocated to the corresponding IMPLAN industry sectors as an 'Industry Change' to measure the impact on the industries experiencing the change in production. The indirect and induced benefits that arose from these expenditures were modeled using the IMPLAN model. This generated estimates of the total impact of capital and non-payroll spending on jobs, personal income, value added (or Gross State Product), and tax revenue collected statewide as well as from the specific study sub-areas: NoVA, Other Urban Areas, and Rural Areas (with transit services).

Table 4-1 Industry Output Concentration in the Study Area as Compared to the Nation

Location Quotient (LQ)	Industry Value Added Concentration in Virginia Compared to the U.S.	Allocation Factor
LQ ≥ 1.00	All local	1.00
0.75 < LQ ≤ 1.00	Mostly local	0.75
0.50 < LQ ≤ 0.75	Even split	0.50
0.25 < LQ ≤ 0.50	Mostly non-local	0.25
LQ < 0.25	All non-local	0.00

The amount of non-payroll operating and capital expenditures in the state was allocated to the corresponding IMPLAN industry sectors.

4.3 Economic Benefits

The total economic benefits generated by the enterprise spending on transit services is presented in **Table 4-2**. These impacts did not take into account the productivity gains from transit due to reduced congestion, improved travel times, and the provision of increased and affordable mobility options.

Table 4-2 Total Economic Impacts Generated by the Operating (Payroll and Non-Payroll) and Capital Spending on Transit Services in Virginia, FY2018

Study Area	Employment (Full-Time Jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
NoVA	13,690	$963	$1,709	$275
Urban Areas	4,260	$305	$589	$88
Rural Areas	330	$29	$39	$10
Commonwealth of Virginia	**18,280**	**$1,297**	**$2,338**	**$373**

Note:

1. Outputs from the IMPLAN economic models for NoVA, Other Urban Areas, and Rural Areas (with transit services) as well as the Commonwealth of Virginia as a whole.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

5.0 Congestion Relief Benefits

Congestion relief benefits include economic benefits that result from less trips on roadways throughout the state because transit services were present as an alternative option. Riders who chose to use transit modes instead of other motorized modes reduced congestion on roadways, which led to reduced travel times and costs associated with delays for residents, visitors, and businesses. These "user benefits" potentially accrued to both transit and private auto users.

5.1 Travel Time Savings

The travel time cost savings in FY2018 was assessed using the following steps:

Step 1: Estimation of the value of travel time

The value of travel time (VOTT) was estimated using the average hourly wage rate for "all occupations" in the state, shown in **Table 5-1**. This value is used to monetize travel time savings due to the presence of transit options.

Table 5-1 Average Value of Travel Time for Auto and Transit Users

	Value
Hourly wage rate for "all occupations in Virginia = (a)	$26.59

Note:

1. The average hourly wage rate for "all occupations" in the state Virginia comes from the Bureau of Labor Statistics (BLS), Occupational Employment Statistics (OES), Period: May 2018.

Step 2: Estimation of ridership and PMT by trip purpose

The FY2018 ridership and PMT figures shown by agency in **Table 3-6** are distributed into three trip purpose categories: commute, work-related business, and all other purposes. As noted in Chapter 3, this analysis used the following percentages to categorize trips by purpose throughout the state: 61 percent of trips were made for the purposes of commuting to and from work, 4 percent were made for work-related business purposes, and the remaining 35 percent were made for other purposes.

Step 3: Estimation of avoided motorized VMT by trip purpose due to transit use

The PMT by transit mode and trip purpose from step 2 was multiplied by the corresponding mode shift factors for the alternative motorized modes shown in **Table 3-7:** "drive alone", "ride with someone", and "taxi/ride hailing". As shown in **Table 5-2**, this step yielded 531.6M VMT saved annually due to transit use.

Table 5-2 Avoided Motorized VMT due to Transit Use in Virginia, FY2018

Trip Purpose	Avoided Annual VMT
Commute (Work) Trips	324,288,217
Work-Related Business Trips	21,264,801
"All Other Purposes" Trips	186,067,010
Total Avoided Annual VMT	531,620,029

Step 4: Estimation of hours of travel saved by highway users due to the presence of transit

The avoided motorized VMT by trip purpose was used to estimate the corresponding change in average travel time per VMT. This time savings per mile is applied to the existing VMT on Virginia primary and secondary roadways. This approach yielded 20.8M hours of travel saved for highway users due to riders choosing transit over an alternative motorized mode (**Table 5-3**). Time savings from transit use accruing to commute and business trips were valued at $681.5M in FY2018 and have rippled through the state economy to support the creation of 1,445 full-time jobs. These jobs add $81M in personal income, $149M in GSP, and $30M in tax revenue.

Step 5: Monetization of the avoided motorized VHT by trip purpose due to transit

In this step the avoided motorized VHT was multiplied by the average hourly wage rate for "all occupations" in Virginia. This monetization, summarized in **Table 5-3**, yielded $615.1M in travel time savings due to riders choosing transit over an alternative motorized mode.

Table 5-3 Travel Time Savings due to Transit Use in Virginia, FY2018

Item	Value (2018$)
VOTT (per person-hour) = (a)	$26.59
Avoided VHT = (b)	23,134,792
Travel Time Savings = (a) x (b)	**$ 615,154,127**

5.2 Avoided Cost of Delays

Transit services continue to move more people than vehicles using less space, which has helped reduce traffic congestion and emissions from idling vehicles as well as improve overall traffic safety lessening individual stressors from driving in congestion. Quantitatively demonstrating the extent of congestion problems facing Virginia's urban areas has illustrated how transit reduces congestion and improves highway performance.

The Texas Transportation Institute (TTI) estimated traffic congestion has become a perennial and growing problem in Virginia's urbanized areas. Drivers in selected urban areas in Virginia have lost nearly 340M hours in 2017, which is a 7.5 percent increase from losing 315M hours in 2014 (**Table 5-4**). Drivers in Washington DC-VA-MD urban area have lost twice as many hours from sitting in traffic delays in 2017

(247.8M hours) as they lost in 1997 (123.4M hours). Highway users in Richmond and Virginia Beach also bear a significant burden due to traffic congestion. Since 1997, traffic delays have increased by 60 percent in Richmond and three-fold in Virginia Beach (**Figure 5-1**). This analysis has shown that the annual hours of delay per daily VMT varies among VA urbanized areas, from 0.83 in Bristol TN-VA to 2.76 in Washington DC-VA-MD (**Table 5-5**).

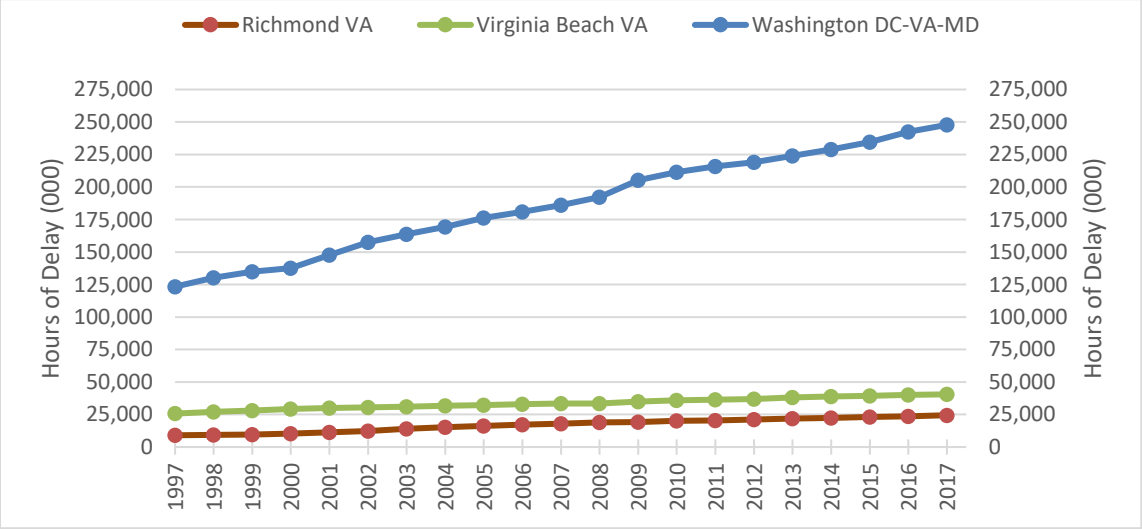
Table 5-4 Total Hours of Traffic Delays in Selected Urbanized Areas in Virginia, 2014-2017

	Urbanized Areas	Annual Hours of Delay (Thousands)				Change, 2014-2017
		2014	2016	2016	2017	
1	Blacksburg VA	1,125	1,229	1,334	1,439	27.9%
2	Bristol TN-VA	1,452	1,560	1,668	1,776	22.3%
3	Charlottesville VA	4,277	4,348	4,421	4,495	5.1%
4	Fredericksburg VA	4,385	4,454	4,524	4,595	4.8%
5	Harrisonburg VA	1,819	1,832	1,846	1,859	2.2%
6	Lynchburg VA	3,599	3,617	3,634	3,651	1.4%
7	Richmond VA	22,416	23,120	23,678	24,461	9.1%
8	Roanoke VA	5,622	5,634	5,645	5,657	0.6%
9	Virginia Beach VA	39,001	39,492	40,180	40,510	3.9%
10	Washington DC-VA-MD	228,900	234,531	242,340	247,811	8.3%
11	Winchester VA	2,598	2,613	2,629	2,644	1.8%
	Total	**315,194**	**322,430**	**331,899**	**338,898**	**7.5%**

Note:

1. Data Source: The Texas Transportation Institute, Urban Mobility Report 2019.

Figure 5-1 Hours of Traffic Delays in the Three Largest Urban Areas in Virginia, 1997-2017



Note:

1. Source: Texas Transportation Institute (TTI), 2019 Urban Mobility Report.

Table 5-5 Annual Hours of Delay per Daily VMT in Virginia Urbanized Areas, 2017

Year	Daily Freeway and Arterial Daily VMT (000)	Annual Hours of Delay (000)	Annual Hours of Delay per Daily VMT
Blacksburg VA	846	1439	1.70
Bristol TN-VA	2,134	1776	0.83
Charlottesville VA	1,299	4495	3.46
Fredericksburg VA	2,736	4595	1.68
Harrisonburg VA	1,007	1859	1.85
Lynchburg VA	1,536	3651	2.38
Richmond VA	23,544	24461	1.04
Roanoke VA	4,092	5657	1.38
Virginia Beach VA	27,814	40510	1.46
Washington DC-VA-MD	89,857	247811	2.76
Winchester VA	1,352	2644	1.96

Note:

1. Data Source: The Texas Transportation Institute.

Estimating benefits from reduced congestion and avoiding delays involved the following steps:

Step 1: Estimation of avoided motorized VMT by trip purpose due to transit use

The PMT by transit mode and trip purpose was multiplied by the corresponding mode shift factors for "drive alone", "ride with someone", and "taxi/ride hailing" shown in **Table 3-7** to obtain an estimate of the avoided alternative motorized VMT by trip purpose due to transit use.

Step 2 - Estimation of avoided annual hours of delay due to transit services

Using the data provided by the TTI Urban Mobility Report, this analysis estimated the annual hours of delay per unit increase in daily passenger VMT in the areas served by transit services. As shown in **Table 5-6**, a unit increase in daily passenger VMT in Richmond would add 1.04 hours in annual traffic delay while a unit increase in daily passenger VMT in NoVa would add 2.76 hours in annual traffic delay.

Table 5-6 Annual Hours of Delay per Daily VMT in Richmond, Virginia Beach and Washington DC-VA-MD, 2007-2017

Transit Agencies	Annual Hours of Delay per a Unit Increase in Daily VMT
WMATA, Fairfax Connector, CUE (City of Fairfax), ART (Arlington), DASH (Alexandria), Loudoun County, PRTC, VRE	2.76
GRTC, PAT (Petersburg)	1.04
HRT (Hampton Roads Transit), WATA (Williamsburg), and Suffolk Transit	1.46
Remaining Transit Agencies	1.90

Converting avoided annual VMT from alternative motorized modes to avoided daily VMT for each of the areas served by transit used annualization factors by trip purpose from the Virginia travel demand model. The avoided daily VMT for each of the areas served by transit was multiplied by the corresponding annual hours of delay per daily VMT shown in **Table 5-6**, yielding the number of annual hours of delay saved by transit. This estimation indicates that transit service saves nearly 4.8M hours in delays annually (**Table 5-7**).

Step 3: Monetization of the avoided annual hours of delay due to transit.

This step involved multiplying the avoided annual hours of delay by the average hourly wage rate for "all occupations" in the state Virginia. Since avoided delay is representative of the impact on travel reliability, a lower cost per hour at half the wage rate ($13.30) was used for commuting and other trips purposes to more accurately take an average of the monetary benefit. Travel mode choice comes with the risk of reliability. Actual pay per hour does not equate stated pay per hour because of time spent commuting. The more time lost commuting by choosing a more unreliable travel mode equals a lower average pay per hour. Therefore, using this lower cost per hour more accurately computes that transit services saved nearly $66.3M in delay costs annually (**Table 5-7**).

Table 5-7 Avoided Cost of Delays due to Transit Services in Virginia, FY2018

Auto Trip Purpose	Avoided Hours of Delay	VOTT (2018$ per person hour)	Total
Commute To and From Work	3,258,650	$13.30	$43,340,050
Work Related Trips	213,682	$26.59	$5,681,804
All Other Purposes	1,303,609	$13.30	$17,337,993
Total	4,775,941		**$66,359,847**

5.3 Economic Benefits

The direct congestion relief benefits of travel time savings and avoided cost of delays account for a total of 22.8M hours saved or $681.5M (**Table 5-8**).

Table 5-8 Congestion Relief Benefits, FY2018

Item	Hours	Value (2018$)
Travel Time Savings	23,134,792	$615,154,127
Avoided Cost of Delays	4,775,941	$66,359,847
Total =	**27,910,733**	**$681,513,974**

To estimate the total (direct, indirect, and induced) economic impact generated by these cost savings, the following assumptions were made to identify the impact on trips that have economic value:

- The economic value of travel time and delay varied by trip purpose. For auto-based commute (work) and non-work trips the economic value equaled the opportunity cost of the time spent travelling. For

business trips (work related) made by private cars or trucks the economic value equaled out of pocket costs associated with each trip.

- Auto Commute Trips - Trips both to and from work have economic value, but this analysis used a conservative approach to estimate this value. For commute trips, the value of travel time was estimated by using 50 percent of the hourly wage rate for "all occupations" in Virginia.

- Auto Business Trips - The value of travel time associated with business trips made by passenger cars was equal to the "out-of-pocket" or "on-the-clock costs" associated with each trip, so it valued at 100 percent of the hourly wage rate for "all occupations" in Virginia.

- Auto "All Other Purpose" Trips - The value of travel time associated with all other purpose trips was assumed to only represent opportunity costs, so it is used to estimate efficiency benefits but not as input into the economic impact analysis.

The travel time savings for trips with economic value accounted for 18.3M hours and the avoided cost of delays equaled $257.4M. Table 5-9 illustrates that this benefit saved $229.3M to commuters and $28.1M to those making work-related business trips.

The travel time savings and the avoided cost of delays that accrued to trips with economic value, (commute and work-related business trips) was translated into the necessary economic model inputs for the IMPLAN model. Travel time savings that accrued to commuters are input as changes in household spending. Travel time savings that accrued to work-related business trips reduce the cost of conducting business in the state, and therefore, are distributed among the state industries as changes in industry production.

The indirect and induced benefits arising from these travel efficiencies was modeled using the IMPLAN economic model, which estimated the total (direct, indirect, and induced) economic impact of congestion relief benefits on full-time jobs, personal income, value added (Gross State Product or GSP), and tax revenue collected.

Table 5-10 presents the total economic impacts from travel time savings and avoided cost of delays transit services have generated statewide as well as within the study's specific sub-areas: NoVA, Other Urban Areas, and Rural Areas (with transit services).

Table 5-9 Travel Time Savings and Avoided Delays Accruing to Trips with Economic Value, FY2018

Trips with Economic Value	Travel Time Savings (Hours)	Travel Time Savings (2018$)
Commute (Work) Trips	14,112,223	$187,692,570
Work-Related Business Trips	925,392	$24,606,165
Total =	**15,037,615**	**$212,298,735**
Trips with Economic Value	**Avoided Delays (Hours)**	**Avoided Cost of Delays (2018$)**
Commute (Work) Trips	3,128,381	$41,591,821
Work-Related Business Trips	131,333	$3,492,150
Total =	**3,259,714**	**$45,083,971**
Trips with Economic Value	**Total Hours Saved**	**Total Savings (2018$)**
Commute (Work) Trips	17,240,604	$229,284,391
Work-Related Business Trips	1,056,725	$28,098,315
Total Savings =	**18,297,329**	**$257,382,706**

Table 5-10 Total Economic Impacts from Travel Time Savings and Avoided Delays due to Transit Service, FY2018

Study Area	Employment (Full-Time Jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
NoVA	1,143	$66	$122	$25
Urban Areas	294	$14	$28	$6
Rural Areas	8	$0.29	$0.59	$0.10
Commonwealth of Virginia	**1,445**	**$81**	**$149**	**$30**

Note:

1. Outputs from the IMPLAN economic models for NoVA, Other Urban Areas, and Rural Areas (with transit services) as well as statewide.
2. The number of jobs estimated by IMPLAN were converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

6.0 Net Traffic Crash Reduction - Cost Savings

The use of transit modes instead of other motorized modes reduced the number of vehicles on Virginia roadways in 2018, which in turn reduced vehicle collisions and incidents. The net crash cost savings due to transit use was calculated using the following steps.

Step 1: Collection of the internal and external unit crash costs by travel mode

Total crash costs include *internal costs*, defined as damages and risks to an individual traveling by a particular vehicle or mode, and *external costs*, defined as uncompensated damages and risks imposed by an individual on other people. *Internal costs* are assigned to passenger miles, while *external costs* are assigned to vehicle miles. *External costs* do not increase with vehicle occupancy while *internal costs* increase as vehicle occupancy increases.

For example, a vehicle carrying only one person imposes only about 10 percent of the internal crash risk as a vehicle carrying ten people, but the external crash risk is considered the same for both. This would imply higher internal costs associated with the vehicle with 10 passengers, but the external costs would be the same in both circumstances. This analysis used the crash cost values depicted in **Table 6-1**.

Table 6-1 Unit Crash Cost by Travel Mode

Vehicle Class	Average Internal Crash Costs		Average External Crash Costs	
	per passenger mile (2007$)	per passenger mile (2018$)	per vehicle mile (2007$)	per vehicle mile (2018$)
Passenger Car	$0.083	$0.101	$0.055	$0.067
Rideshare Vehicle	$0.083	$0.101	$0.000	$0.000
Transit Vehicle (Bus)	$0.004	$0.005	$0.264	$0.320

Notes:

1. The unit crash costs by travel mode in 2007$ comes from the Victoria Transport Policy Institute. *Transportation Cost and Benefit Analysis II – Safety and Health Costs* (May 18, 2016).
2. The unit crash costs were inflated from 2007 to 2018 dollars using the Consumer Price Index (CPI) for all urban consumers (CPI-U) from the Bureau of Labor Statistics (BLS).

Step 2: Estimation of the external crash cost savings from avoided motorized VMT due to transit use

In this step, the avoided motorized VMT due to transit use was multiplied by the corresponding average external crash cost shown in **Table 6-1**.

Step 3: Estimation of transit VRM that would be displaced by the alternative motorized modes

This was estimated by multiplying the transit VRM shown in **Table 3-6** by the combined mode shift factors for ‘drive alone’, ‘ride with someone’, and ‘taxi/ride hailing’ depicted in **Table 3-7.**

Step 4: Estimation of the external crash cost associated with the displaced transit VRM

This was estimated by multiplying the VRM that would be displaced by the alternative motorized modes by the corresponding average external crash cost for transit vehicles (buses) shown in **Table 6-1**.

Step 5: Estimation of net external crash cost savings due to transit use

The annual net external crash cost savings due to transit use was estimated by subtracting the external transit crash costs associated with the displaced VRM (Step 4) from the external crash cost resulting from the avoided motorized VMT (Step 3).

Step 6: Estimation of the internal crash cost resulting from the avoided motorized VMT due to transit use

In this step the avoided motorized VMT due to transit use was multiplied by the average vehicle occupancy (AVO) rates for 'drive alone', 'ride with someone', and 'taxi/ride hailing' shown in **Table 6-2,** and then multiplied again by the corresponding average internal crash cost shown in **Table 6-1**.

Table 6-2 Average Vehicle Occupancy Rates for Alternative Motorized Modes

Drive Alone	Ride with Someone	Taxi / Ride-Hailing
1.0	2.5	2.5

Step 7: Estimation of transit PMT displaced by the alternative motorized modes

This was estimated by multiplying the transit PMT shown in **Table 3-6** by the combined mode shift factors for 'drive alone', 'ride with someone', and 'taxi' depicted in **Table 3-7**.

Step 8: Estimation of the internal transit crash costs associated with displaced PMT

This was estimated by multiplying the PMT displaced by the alternative motorized modes by the corresponding average internal crash cost shown in **Table 6-1**.

Step 9: Estimation of net internal crash cost savings due to transit use

The annual net internal crash cost savings due to transit use was estimated by subtracting the internal transit crash costs associated with the displaced PMT (obtained in Step 8) from the internal crash cost resulting from the avoided motorized VMT (obtained in Step 7).

Step 10: Estimation of the net crash cost savings

The sum of the net external and internal crash cost savings estimated in steps 5 and 9, respectively, represents the net safety benefits generated by transit. As shown in **Table 6-3**, these savings account for $59.6M. Safety benefits do not have a multiplier effect in the state economies, and therefore, they are not an input into the IMPLAN economic model.

Table 6-3 Net Crash Cost Savings from Transit Services in Virginia, FY2018

Item	Crash Costs (2018$)
Avoided Alternative Motorized Modes = (a)	$84,994,407
Transit Vehicles (Buses) = (b)	$25,357,253
Net Savings = (a) – (b)	$59,637,154

7.0 Increased/Affordable Mobility

Increased/affordable mobility captures the benefits that arise from providing additional, more affordable travel options to those living in communities with access to transit. This includes the economic activity generated by providing a match between transit demand (e.g. potential riders) and transit supply (e.g. high capacity, efficient routes), links to other transportation modes, and access to demand-response services in areas that do not have density to warrant regular bus service. This also includes the economic activity generated by providing mobility, cost savings, and access to additional employment opportunities to residents without access to personal vehicles or other forms of dependable transportation.

These benefits were calculated by estimating the "expenditure value benefit" and the "forgone employment benefit" that would result from the absence of transit as a travel option. The "expenditure value benefit" includes transportation costs that result when would-be transit riders shift to other modes of travel in the absence of transit, and the "forgone employment benefit" includes the number of employment opportunities that are lost when transit-dependent riders are left with no other means to travel to and from work or make other business-related trips.

7.1 Net Transportation Cost Savings

Transit service provides a potential reduction in transportation costs to those who use transit modes in place of another mode of travel to satisfy their transportation needs (i.e., travel to work, shop, school, etc.). This benefit was calculated using following steps:

Step 1: Estimation of marginal vehicle operating cost (VOC) associated with alternative transportation modes

Vehicle operating costs (VOC) equaled operation costs and ownership costs. Operation costs included money spent on both fuel and non-fuel expenses, including regular maintenance (e.g., oil and fluid changes, tire rotations, tire replacement, and wiper replacement). Ownership costs included lease or purchase payments, registration and taxes, insurance, permits and licenses, depreciation, and other costs related to the ownership of commercial vehicles. Average passenger VOC figures were obtained from the American Automobile Association (AAA).

Table 7-1 illustrates the average VOC for all alternative motorized travel modes used in this analysis, which were determined based on the following data:

- **Passenger Vehicles:** The average marginal VOC per year was set to $0.7531 per vehicle mile travelled (VMT) for vehicles travelling 10,000 miles per year based on data provided by AAA.
- **Taxis:** The average marginal VOC was based on average rates per mile charged by taxis in the areas served by transit according to the Taxi Fare Finder. These rates included a base fare (a flat fee charged at the beginning of the ride) and a booking fee (formerly known as the "safe rides fee") on top of the cost per mile.
- **Ride-Hailing:** The average marginal VOC was determined based on the average per mile rate charged by Uber and Lyft in the areas served by transit. These rates included a base fare (i.e., a flat

fee charged at the beginning of the ride) and a booking fee (formerly known as the "safe rides fee") on top of the cost per mile.

Table 7-1 Average Marginal Vehicle Operating Costs (VOC) of Alternative Motorized Modes

Item	Passenger Vehicle	
Average VOC (2018$/VMT)	$0.7531	
Item	**Taxi**	**Ride-Hailing (Lyft)**
Average Initial Charge (2018$)	$3.11	$1.52
Average Service Fee (2018$)	---	$2.92
Average Fee per Mile (2018$/VMT)	$2.15	$1.12

Notes:

1. The average VOC for "drive alone" corresponds to the marginal VOC for vehicles travelling 10,000 miles per year provided by the *American Automobile Association (AAA), Your Driving Costs, 2018 Edition*. Average passenger car VOC per mile traveled included costs for fuel, maintenance, tires, full-coverage insurance, fees (license, registration and taxes), depreciation, and financing.

2. The average initial charge and per mile fee for taxis was estimated using the TaxiFareFinder: US Taxicab Rate Ranking Chart for the cities of Leesburg, Fairfax, Falls Church, McLean, Reston, Tysons Corner, Vienna, Alexandria, Charlottesville, Arlington, Dulles, Sterling, Roanoke, Richmond, Manassas, Woodbridge, Norfolk, Newport News, Yorktown, and Winchester. This information is available at https://www.taxifarefinder.com/rates.php.

3. The initial charge, service fees and per mile fee for ride-hailing services was estimated based on Lyft rates in the cities of Charlottesville, Fredericksburg, Harrisonburg, Lynchburg, Richmond, Roanoke and Virginia Beach. This information is available at https://estimatefares.com/rates/.

Step 2: Estimation of VOC savings associated with the avoided motorized VMT due to transit use

In this step the avoided motorized VMT was multiplied by the corresponding marginal VOC shown in **Table 7-1.**

Step 3: Estimation of parking cost savings associated with the avoided 'drive alone' VMT by trip purpose

Spending on parking was estimated by converting the 'drive alone' VMT for commute, work-related business, and all other purpose trips into trip counts using the average trip lengths by trip purpose shown in **Table 7-3** and the average daily and hourly parking prices shown in **Table 7-3**. This analysis assumed that commuters would pay daily parking fees while people making work-related business trips and all other purpose trips would park for four hours and therefore, they would be charged the average hourly parking fee. This analysis also assumed that people who "ride with someone" or take taxi/ride-hailing do not have to pay for parking.

Table 7-2 Estimated Average Trip Length by Trip Purpose in Virginia

Item	Drive Alone, Commute Trips	Drive Alone, Work-Related Business Trips	Drive Alone, "All Other Purposes" Trips
Average Trip Length (miles)	12.8	27.4	9.1

Note:

1. Average trip lengths by trip purpose are estimated based on data provided by the U.S. DOT, FHWA, Summary of Travel Trends: 2017 National Household Travel Survey (July 2018).

Table 7-3 Estimated Daily Parking Costs in Virginia

Item	Drive Alone, Commute Trips	Drive Alone, Work-Related Business Trips	Drive Alone, All Other Purpose Trips
Estimated Number of Hours Parked	---	4	4
Average Hourly Parking Price	---	$2.0	$2.0
Average Daily Parking Price	$12.0	$8.0	$8.0

Note:

1. The average hourly and daily parking costs come from **Table 3-11.**

Step 4: Estimation of transportation costs savings associated with the avoided motorized VMT due to transit

The VOC savings plus the parking cost savings estimated in steps 2 and 3 represent the transportation cost savings due to avoided motorized VMT. These savings account for $521.3M.

Step 5: Estimation of transit riders displaced by the alternative motorized modes

In this step the ridership shown in in **Table 3-6** was multiplied by the combined mode shift factors for "drive alone", "ride with someone", and "taxi/ride-sharing" depicted in **Table 3-7** for each of the 41 transit agencies in Virginia.

Step 6: Estimation of transit fares paid by transit riders who would have to shift to alternative motorized modes in the absence of transit

The number of displaced transit riders who would have to shift to alternative motorized modes in the absence of transit was multiplied by the corresponding average transit fare per unlinked trip shown in **Table 7-4** for each of the 41 transit agencies in Virginia. These costs account for $223.9M.

Step 7: Estimation of net expenditure value benefit

The annual net expenditure value benefit due to transit was estimated by subtracting the transportation costs incurred by displaced transit riders (step 6) from the transportation costs savings associated with the avoided motorized VMT due to transit (step 4). These savings represent $297.4M as shown in **Table 7-4**.

Table 7-4 Net Expenditure Value Benefit Generated by NCTD Services

Item	Value (2018$)
Transportation costs savings associated with the avoided motorized VMT due to transit use = (a)	$521,286,904
Transportation costs incurred by transit riders who would have to shift to alternative motorized modes in the absence of transit = (b)	$223,903,259
Net Expenditure Value Benefit = (a) – (b)	**$297,383,645**

7.2 Forgone Employment Benefit

Transit increases access to jobs and services for all individuals, but this access is particularly important for people with no private means of transportation. This means that transit has contributed greatly to the economic well-being of population groups that are less likely to own vehicles, such as low-income individuals, seniors, persons with disabled, and students. The forgone employment value of transit services in Virginia for transit dependent residents was determined by calculating the jobs (or opportunities to conduct business) lost when passengers forgo job-related trips in the absence of transit services. This assessment included the following steps:

Step 1: Estimation of the avoided VMT resulting from trips forgone in the absence of transit

The PMT by trip purpose was multiplied by the "not make trip" mode shift factor shown in **Table 3-7**. This yielded the avoided VMT resulting from transit riders who would have to forgo their trips if transit was not an option.

Step 2 - Estimation of forgone commute (work) and work-related business trips in the absence of transit

The avoided VMT associated with commute (work) and work-related business trips was multiplied by the average transit trip lengths shown in **Table 7-3.**

Step 3: Estimation of number of transit riders who would have to forgo their commute (work) and work-related business trips in the absence of transit

The forgone commute and work-related business trips (Step 2) was multiplied by the annual number of commute and work-related business trips per person shown in **Table 7-5**.

Table 7-5 Annual Number of Commute and Work-Related Business Trips per Person

Item	Commute To and From Work	Work-Related Business Trips
Annual Number of Trips per Person	214	20

Note:

1. Source: U.S. Department of Transportation. Federal Highway Administration. FHWA-PL-18-019. Summary of Travel Trends: 2017 National Household Travel Survey. July 2018.

Step 4: Estimation of the number of transit dependent riders who would lose their income because they would have to forgo their commute (work) and work-related business trips in the absence of transit

This was estimated by multiplying the number of transit riders who would have to forgo their commute (work) and work-related business trips (step 3) by their labor income. This analysis assumed that transit riders from households that make less than $50,000 per year would lose their income because they cannot get to work or make work-related business trips in the absence of transit. As shown in **Table 7-6**, this analysis estimated that over 75,000 transit dependent riders have the potential to earn $1.5B in labor income because they can get to work or make business trips using transit.

Table 7-6 Forgone Employment Benefit Accruing to Transit Dependent Riders, FY2018

Household Income Range	Number of Workers	Average Annual Income	Forgone Income (2018$)
Less than $9,000	9,364	$8,000	$74,909,160
$10,000 - $14,999	24,162	$13,500	$326,186,479
$15,000 - $24,999	25,955	$20,000	$519,094,023
$25,000 - $34,999	12,606	$30,000	$378,168,912
$35,000 - $49,999	3,623	$42,500	$153,982,359
Total =	**75,709**		**$1,452,340,933**

7.3 Economic Benefits

The net expenditure value benefit and the forgone employment benefit represent the increased/ affordable mobility benefits generated by transit services. As shown in **Table 7-7**, these benefits account for nearly $1.8B.

Table 7-7 Net Expenditure Value Benefit Generated by Transit Services in Virginia, FY2018

Transit Mode	Value (2018$)
Net Expenditure Value Benefit = (a)	$297,383,645
Forgone Employment Benefit = (b)	$1,452,340,933
Increased/Affordable Mobility Benefits = (a) + (b)	**$1,749,724,578**

The net expenditure value benefit and the forgone employment benefit generated by transit services in Virginia was converted into the necessary model inputs for the IMPLAN economic model. The net expenditure value benefit was an input as a change in household spending, and the forgone employment benefit was an input as a change in labor income.

The indirect and induced benefits that arose from increased and affordable mobility options was modeled using the IMPLAN economic model, which estimated the total (direct, indirect, and induced) economic impact of increased/affordable mobility on full-time jobs, personal income, value added (Gross State Product or GSP), and tax revenue collected. **Table 7-8** presents the total economic impacts from the net expenditure value and the forgone employment benefits transit services have generated statewide as well as from the study's specific sub-areas: NoVA, Other Urban Areas, and Rural Areas (with transit services).

Table 7-8 Total Economic Impacts from Increased/ Affordable Mobility due to the Presence of Transit as an Option, FY2018

Study Areas	Employment (Full-Time jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$)
NoVA	7,255	$406	$773	$153
Urban Areas	1,910	$89	$174	$38
Rural Areas (with Transit)	50	$1.67	$3.54	$0.98
Commonwealth of Virginia	**9,215**	**$496**	**$951**	**$193**

Note:

1. Outputs from the IMPLAN economic models for NoVA, Other Urban Areas, and Rural Areas (with transit services) as well as statewide.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

8.0 Environmental Sustainability

Promoting environmental sustainability is a high priority for the state. While there are many potential measures of sustainability related to transit service, this analysis focused on vehicle emissions and fuel consumption.

Vehicle emissions from six key pollutants have increased air pollution: Carbon Monoxide (CO), Nitrogen Oxides (NOx), Fine Particular Matter ($PM_{2.5}$), Sulfur Dioxide (SO_2), Volatile Organic Compounds (VOCs), and the greenhouse gas Carbon Dioxide (CO_2). Of these pollutants, particulate matter has the greatest negative human health and economic impacts (e.g., mortality, morbidity, lost income from work absence, health care costs).

The quantity of vehicular emissions that enter the atmosphere has been directly related to the amount and types of fuel consumed by every vehicle in the transportation sector. Though some transit vehicles have been less fuel efficient on a per mile basis, transit modes on the whole have consumed less fuel and have emitted less pollutants than personal vehicles due to economies and efficiencies of scale. Air quality has improved from less fuel consumed and less pollutants emitted when the same number of people have travelled in transit modes in place of private automobiles. This has created overall social value because everyone benefits from breathing cleaner air.

8.1 Social Benefit of Reduced Emissions

To estimate the social benefit of reduced emissions due to transit use, emission damage costs were assessed and compared across travel modes. These damage costs were calculated as a function of the running emission rates of each pollutant (determined by travel speed and vehicle type), monetized damage costs per unit of each pollutant, and VMT by vehicle type. The net emission cost savings due to transit use in place of alternative motorized modes were estimated using the following steps:

Step 1. Collection of running emission rates by vehicle type

This analysis utilized the running emission rates of CO, CO_2, NOx, $PM_{2.5}$, SO_2, and VOC for passenger cars shown in **Table 8-1**, and the emission rates of CO, NOx, PM5 and VOCs for transit buses and vans shown in **Table 8-2**. The analysis did not estimate emissions costs associated with transit CO2 emissions.

Step 2. Collection of damage costs per unit of each major pollutant

This analysis used the emission unit costs for major pollutants recommended by the U.S. Department of Transportation and the Federal Transit Administration (FTA) presented in **Table 8-3**.

Table 8-1 Running Emission Rates of Major Pollutants for Passenger Cars

Speed (mph)	CO (g/VMT)	CO_2 (g/VMT)	NO_X (g/VMT)	$PM_{2.5}$ (g/VMT)	SO_2 (g/VMT)	VOCs (g/VMT)
20	2.1504	551.12	0.1999	0.0037	0.0055	0.0987
21	2.0928	532.04	0.1948	0.0035	0.0053	0.0934
22	2.0353	512.95	0.1897	0.0033	0.0052	0.0881
23	1.9777	493.87	0.1846	0.0031	0.0050	0.0828
24	1.9202	474.78	0.1795	0.0029	0.0048	0.0775
25	1.8626	455.70	0.1744	0.0027	0.0046	0.0722
26	1.8252	442.81	0.1719	0.0026	0.0045	0.0693
27	1.7878	429.93	0.1693	0.0025	0.0043	0.0663
28	1.7504	417.04	0.1668	0.0024	0.0042	0.0633
29	1.7130	404.16	0.1643	0.0023	0.0041	0.0603
30	1.6756	391.27	0.1617	0.0021	0.0039	0.0573
31	1.6579	383.46	0.1613	0.0021	0.0039	0.0559
32	1.6402	375.65	0.1608	0.0020	0.0038	0.0544
33	1.6225	367.83	0.1603	0.0019	0.0037	0.0529
34	1.6048	360.02	0.1598	0.0019	0.0036	0.0515
35	1.5870	352.21	0.1593	0.0018	0.0035	0.0500
36	1.5734	347.40	0.1594	0.0017	0.0035	0.0491
37	1.5598	342.60	0.1594	0.0017	0.0034	0.0482
38	1.5462	337.79	0.1594	0.0017	0.0034	0.0474
39	1.5326	332.99	0.1594	0.0016	0.0033	0.0465
40	1.5190	328.18	0.1594	0.0016	0.0033	0.0456
41	1.5076	325.84	0.1598	0.0015	0.0033	0.0452
42	1.4963	323.50	0.1602	0.0015	0.0033	0.0449
43	1.4849	321.16	0.1607	0.0015	0.0032	0.0445
44	1.4736	318.82	0.1611	0.0015	0.0032	0.0441
45	1.4622	316.48	0.1615	0.0015	0.0032	0.0438
46	1.4550	316.61	0.1623	0.0014	0.0032	0.0438
47	1.4478	316.74	0.1631	0.0014	0.0032	0.0438
48	1.4405	316.87	0.1639	0.0014	0.0032	0.0437
49	1.4333	317.01	0.1647	0.0014	0.0032	0.0437
50	1.4261	317.14	0.1655	0.0014	0.0032	0.0437

Notes:

1. Source: California Department of Transportation (Caltrans), California life-Cycle Benefit/Cost Analysis Model (Cal-B/C) 6.2, December 2017.

Table 8-2 Emission Rates of Major Pollutants for Transit Vehicles (Buses and Vans) by Propulsion Type

Fuel	Average Emission Rates (in grams per mile) in VA Urban Areas			
	CO	NO_X	VOCs	$PM_{2.5}$
CNG	9.7206	5.3190	0.7623	0.0772
Diesel/Hybrid Diesel	4.1124	11.0640	0.6594	0.3219
Gas	31.3613	2.8478	1.1628	0.0499

Fuel	Average Emission Rates (in grams per mile) in VA Rural Areas			
	CO	NO_X	VOCs	$PM_{2.5}$
CNG	8.6385	4.7444	0.5960	0.0739
Diesel/Hybrid Diesel	3.3351	8.8210	0.5332	0.2699
Gas	24.3489	2.3458	1.6035	0.0463

Note:

1. These emission rates for urban and rural areas in Virginia were estimated by Cambridge Systematics using MOVES2014.

Table 8-3 Pollutant Damage Unit Costs

Pollutant Type	Unit Damage Cost (2018$)
VOCs	$2,100 per short ton
NOx	$8,600 per short ton
$PM_{2.5}$	$387,300 per short ton
SO_2	$50,100 per short ton
CO_2	$1 per metric ton
CO	$80 per short ton

Notes:

1. The damage unit costs for VOCs, NOx, $PM_{2.5}$, and SOx come from the *U.S. DOT Benefit-Cost Analysis Guidance for Discretionary Grant Programs*, January 2020. Available at https://cms8.dot.gov/sites/dot.gov/files/2020-01/benefit-cost-analysis-guidance-2020_0.pdf
2. The damage unit cost for CO was estimated based on the damage unit costs for CO in 2013 and 2023 provided in the *Propose New Starts and Small Starts Policy Guidance*, U.S. DOT, Federal Transit Administration, January 9, 2013.

Step 3: Estimation of the emission cost savings due to avoided alternative motorized VMT

Emission rates for CO, NOx, $PM_{2.5}$, SO_2, and VOC were selected from **Table 8-1** based on the average speed of each motorized travel mode. The emission rates were then multiplied by the estimated motorized VMT avoided due to transit use, converted to short tons, and multiplied by the corresponding pollutant unit damage cost in **Table 8-3**. The same calculation was performed for CO2 using metric tons as the unit of analysis instead of short tons.

Step 4: Estimation of emission costs attributed to transit use

Emission rates by propulsion type from **Table 8-2** were multiplied by the corresponding transit vehicle revenue miles (VRM) that would be displaced by alternative motorized travel modes if transit were not available. This step relied on the propulsion type summary presented in Section 3.3 to assign emissions rates proportionally to transit travel in a manner that accurately reflected the makeup of the Virginia transit fleet. The product of this calculation was then converted to short tons and multiplied by the corresponding pollutant unit damage cost in **Table 8-3**.

Step 5: Net emission damage cost savings attributed to transit use

The net emission cost savings was estimated by subtracting the annual costs attributed to transit use (step 4) from the annual costs attributed to alternative motorized mode use in the absence of transit services (step 3). As shown in Table 8-4, these savings account for $12.8M.

Table 8-4 Net Emission Cost Savings from Transit Services in Virginia, FY2018

Item	Emissions Costs (2018$)
Emission cost savings attributed to avoided alternative motorized VMT= (a)	$17,661,762
Emission cost attributed to bus and paratransit VRM = (b)	$4,835,404
Net Savings = (a) – (b)	**$12,826,358**

Notes:

1. CO_2 emissions attributed to transit use are not included in this analysis due to data constraints, however this has a minor impact on the net cost savings based on the low unit damage costs for CO2 ($1 per metric ton).

The emission benefits summarized here do not have a multiplier effect in the state economy and are not an input into the IMPLAN economic model.

8.2 Social Benefit of Reduced Fuel Consumption

Fuel consumption rates were assessed and compared across travel modes to estimate the social benefit of reduced fuel consumption attributed to transit use. This assessment of these social benefits included the following steps:

Step 1. Collection of fuel consumption rates for alternative motorized modes and transit modes

For alternative motorized modes (e.g., “drive alone”, “ride with someone”, and taxi/ride-hailing), this analysis used the average fuel consumption rates provided by the California Air Resources Board Emission Factor (EMFAC) 2014 Model (**Table 8-5**). The U.S. Environmental Protection Agency (EPA) has approved this model.

Table 8-5 Average Fuel Consumption Rates for Private Passenger Cars

Speed (mph)	Fuel Consump. Rate (gal/VMT)	Speed (mph)	Fuel Consump. Rate (gal/VMT)	Speed (mph)	Fuel Consump. Rate (gal/VMT)	Speed (mph)	Fuel Consump. Rate (gal/VMT)	Speed (mph)	Fuel Consump. Rate (gal/VMT)
5	0.1024	**19**	0.0489	**33**	0.0310	**47**	0.0266	**61**	0.0300
6	0.0971	**20**	0.0465	**34**	0.0303	**48**	0.0266	**62**	0.0306
7	0.0919	**21**	0.0449	**35**	0.0296	**49**	0.0266	**63**	0.0312
8	0.0867	**22**	0.0433	**36**	0.0292	**50**	0.0266	**64**	0.0319
9	0.0815	**23**	0.0417	**37**	0.0288	**51**	0.0268	**65**	0.0325
10	0.0763	**24**	0.0401	**38**	0.0284	**52**	0.0270	**66**	0.0331
11	0.0727	**25**	0.0384	**39**	0.0280	**53**	0.0272	**67**	0.0337
12	0.0691	**26**	0.0374	**40**	0.0276	**54**	0.0274	**68**	0.0343
13	0.0656	**27**	0.0363	**41**	0.0274	**55**	0.0275	**69**	0.0350
14	0.0620	**28**	0.0352	**42**	0.0272	**56**	0.0279	**70**	0.0356
15	0.0584	**29**	0.0341	**43**	0.0270	**57**	0.0283		
16	0.0560	**30**	0.0330	**44**	0.0268	**58**	0.0286		
17	0.0536	**31**	0.0323	**45**	0.0266	**59**	0.0290		
18	0.0513	**32**	0.0316	**46**	0.0266	**60**	0.0293		

Notes:

1. Data Source: American Bus Association Foundation. *Updated Comparison of Energy Use & Emissions from Different Transportation Modes* (June 2019). Prepared by MJB & A.
2. *Passenger miles per diesel equivalent gallon. One diesel equivalent gallon is defined as 138,000 Btu, that is, the energy content of a gallon of "typical" highway diesel fuel in accordance with the National Transit Database data collection instructions.

The average fuel consumption rates for transit modes used in this study (**Table 8-6**) came from a study sponsored by the American Bus Association Foundation titled, *Updated Comparison of Energy Use & Emissions from Different Transportation Modes*. This study compared energy use and emissions for travel modes that used different fuel types, including diesel fuel, gasoline, and electricity. In this analysis, energy use for all modes was expressed in terms of a "diesel equivalent gallon" based on energy content. One diesel equivalent gallon was defined as 138,000 Btu, the energy content of a gallon of "typical" highway diesel fuel in accordance with the National Transit Database data collection instructions.

Table 8-6 Average Fuel Consumption Rates for Transit Modes

Transit Mode	PMT / Diesel Equivalent Gallon*	Transit Mode	PMT / Diesel Equivalent Gallon*
Transit Bus	70.5	**Heavy Rail**	190.6
Ferry Boat	12.5	**Light Rail**	92.0
		Commuter Rail	90.3

Notes:

1. Data Source: American Bus Association Foundation. *Updated Comparison of Energy Use & Emissions from Different Transportation Modes* (April 2014). Prepared by MJB & A.
2. *Passenger miles per diesel equivalent gallon. One diesel equivalent gallon is defined as 138,000 Btu, that is, the energy content of a gallon of "typical" highway diesel fuel in accordance with the National Transit Database data collection instructions.
3. The fuel consumption rates for electric modes (heavy rail and light rail) are based on kilowatt hours of delivered electricity and therefore does not account for the total fuel energy used to generate the electricity.

Step 2: Collection of average annual fuel prices

The U.S. Energy Information Administration (EIA) publishes average annual retail fuel prices for geographic aggregations of the 50 states and the District of Columbia known as Petroleum Administration for Defense Districts (PADDs). This analysis uses the average retail prices of fuel of the Lower Atlantic Sub-district (known as the sub-PADD 1C) in 2018(Table 8.7) , which includes Virginia.

Table 8-7 Average Annual Retail Fuel Prices in the Lower Atlantic Sub-District, 2018

Fuel Type	Average Price (2018$/gallon)
Gasoline, All Grades	$2.671
Diesel, All Grades	$3.061

Notes:

1. Average retail prices of gasoline and diesel in the Lower Atlantic Sub-district (PADD 1C) come from the U.S. Energy Information Administration (EIA). Available at https://www.eia.gov/dnav/pet/pet_pri_gnd_dcus_r1x_a.htm
2. The Blue Bird Corporation estimates that the gallon equivalent of CNG costs up to 60 percent less than the cost of a gallon of diesel fuel. This analysis assumes that the gallon equivalent of CNG costs 50 percent of the gallon of diesel fuel.

Step 3: Estimation and monetization of fuel saved by avoided alternative motorized travel

The amount of fuel saved due to transit use was calculated by multiplying the avoided VMT associated with the alternative motorized modes by the corresponding fuel consumption rates. These savings were monetized by multiplying the number of gallons of fuel saved by the average annual price of gasoline ($2.671) in the Lower Atlantic Sub-district shown in **Table 8-7**.

Step 4: Estimation and monetization of transit fuel consumption associated with displaced transit PMT

The PMT displaced by alternative motorized modes in the absence of transit was divided by the corresponding fuel consumption rates to yield the diesel equivalent gallons of fuel consumed by transit modes. The spending in fuel was monetized by multiplying the number of gallons of fuel consumed by the average annual price of diesel ($3.061) in the Lower Atlantic Sub-district shown in **Table 8-7**.

Step 5: Estimation of net fuel savings due to transit

Estimated transit fuel consumption costs (Step 4) were subtracted from the estimated cost of fuel saved due to the avoided alternative motorized VMT (Step 3). The social benefits resulting from reduced fuel consumption due to transit use in Virginia represented 11.3M gallons of fuel or $27.5M saved (**Table 8-8**).

Table 8-8 Net Fuel Savings from Transit Services in Virginia, FY2018

Item	Fuel Consumption (Gallons)	Fuel Consumption (2018$)
Fuel savings due to avoided alternative motorized modes = (a)	18,229,782	$48,691,749
Fuel consumed by transit modes (PMT displaced by motorized modes) = (b)	6,922,340	$21,189,282
Net Savings = (a) – (b)	**11,307,443**	**$27,502,467**

The dollar value of reduced fuel consumption is not included in the estimation of total economic benefits as these benefits were included in the calculation of the expenditure value benefit discussed in **Section 3.8**.

8.3 Total Environmental Sustainability Benefits

The environmental sustainability benefits of reduced emissions and fuel consumption costs attributed to transit use are summarized in **Table 8-9**. These benefits do not have a multiplier effect throughout the state economy and are not an input into the IMPLAN economic model.

Table 8-9 Environmental Sustainability Benefits from Transit Service in Virginia, FY2018

Item	Fuel Consumption (2018$)
Net savings in emission damage cost = (a)	$12,826,358
Net Savings in fuel consumption = (b)	$27,502,467
Total Net Savings = (a) + (b)	**$40,328,825**

9.0 State of Good Repair of the Roadway Infrastructure Benefits

Transit patronage reduces the total annual costs associated with maintaining Virginia's roadway system in a state of good repair by reducing the number of vehicle miles travelled (VMT) on roads that would contribute to additional wear and tear over time. To quantify this benefit, this study compared current estimated pavement maintenance costs to a scenario in which transit was not an option, by comparing VMT in both circumstances. In such an analysis, lower VMT would lead to improved pavement conditions and lower maintenance costs, whereas higher VMT would imply worse pavement conditions and higher maintenance costs. State of good repair (SOGR) of roadway infrastructure benefits were assessed using the following steps:

Step 1: Estimation of the unit cost associated with pavement maintenance due to auto- and bus-miles traveled

This analysis used the average external marginal pavement maintenance unit costs for urban and rural highways by vehicle type provided by the U.S. Federal Highway Administration (**Table 9-1**). These costs represent all costs borne by public agencies responsible for highway maintenance associated with maintaining pavements that result from a unit increase in VMT. The pavement maintenance unit cost for bus and paratransit vehicle VMT is assumed to be half the average cost associated with a 40 kilopound (kip) 4-axle, single unit truck traveling on urban and rural highways.

Table 9-1 Marginal Pavement Maintenance Unit Cost for All Highways

Vehicle Type / Transit Mode	All Highways (2018$/VMT)
Passenger Car	$0.0015
Bus/Paratransit*	$0.0073

Note:

1. The values in 2000$ come from the U.S. Department of Transportation (US DOT), 1997 Federal Highway Cost Allocation Study, Final Report, Table V-26, available at http://www.fhwa.dot.gov/policy/hcas/final/five.cfm, which.
2. All highways include urban and rural highways.
3. *The average marginal pavement maintenance cost due to bus and paratransit VMT is assumed to be half the marginal pavement maintenance cost due to 40 kip 4-axle single unit truck VMT.
4. The marginal external pavement costs are inflated from 2000 to 2018 dollars using the Consumer Price Index for all urban consumers (CPI-U).

Step 2: Estimation of the pavement maintenance cost associated with avoided motorized VMT due to transit use

The avoided motorized VMT due to transit use was multiplied by the corresponding external pavement unit cost shown in **Table 9-1**.

Step 3: Estimation of pavement maintenance cost associated with transit VRM displaced by alternative motorized modes in the absence of transit

The VMT displaced by the alternative motorized modes was multiplied by the corresponding external pavement unit cost shown in **Table 9-1**.

Step 4: Estimation of the net pavement maintenance cost savings

The annual net savings in pavement maintenance cost due to transit use was estimated by subtracting the pavement maintenance costs associated with transit VRM displaced by alternative motorized modes (step 3) from the pavement_maintenance costs associated with the avoided motorized VMT due to transit use (step 2). As shown in **Table 9-2**, agencies responsible for highway maintenance save $408,466 in pavement maintenance cost due to current level of transit use.

Table 9-2 Net Pavement Maintenance Cost Savings Attributable to NCTD Transit Services, FY2018

Alternative Motorized Modes	Avoided VMT	Unit Pavement Maintenance Cost (2018$/VMT)	Pavement Maintenance Costs (2018$)
Avoided Drive Alone, Ride with Someone, and Taxi/Ride-Healing VMT = (a)	531,620,029	$0.0015	$775,224
Transit	**Displaced Transit VRM**	**Unit Pavement Maintenance Cost (in 2018$/VMT)**	**Pavement Maintenance Costs (in 2018$)**
VRM displaced by the alternative motorized modes = (b)	50,301,742	$0.0073	$366,757
Net Pavement Maintenance Cost Savings (a) – (b)			**$408,466**

The benefits associated with the SOGR of the roadway infrastructure have not a multiplier effect in the state economy and therefore, they are not input into the economic model.

10.0 Additional Transit Benefits

While difficult to quantify, additional benefits statewide have arisen from transit services and have assisted in making decisions on further investments in transit. The presence of transit services throughout Virginia has brought additional benefits to public health and access to social services, the built environment, tourism, residential and commercial property values, and statewide fiscal health. This section summarized these qualitative benefits.

10.1 Benefits to Public Health and Overall Access to Social Services

The presence of transit has increased mobility options for individuals across the state and provided vital connections to those that do not have access to other means of transportation. Transit services have become especially important for persons with disabilities and senior populations throughout the state. Without transit, many of these individuals would not be able to reach destinations such as medical offices, hospitals, grocery stores, and other public amenities. Transit services have also helped seniors to "age in place" by providing mobility to those that no longer drive.

In addition, the presence of transit as a travel option has been found to promote public health and wellbeing. The process of accessing transit stops and stations promotes physical activity and transit use promotes better air and water quality by reducing harmful emissions. Specific mobility and public health benefits associated with transit include:

- **Increased Public Health, Physical Activity, and Air Quality:** Providing more opportunities to walk, bike, and use public transportation instead of driving alone have helped people be more physically active and reduced their chances of developing heart disease, cancer, or diabetes, and suffer strokes and negative effects from stress[12]. More opportunities for alternative transportation have helped improve air and water quality, and has contributed to reduced noise pollution. This, in turn, has had a positive effect on occurrences of asthma, lung disease, lung cancer, and overall mental health issues[13]. Transit use has also reduced the likelihood of injury or death from car crashes[14].

- **Access for Persons with Disabilities:** Access to reliable, physically accessible, affordable transportation has become a prerequisite for living a fully integrated life in America's dispersed communities. Access to healthcare, employment, housing, education, voting facilities, grocery stores, and recreational activities all depend on the availability of transportation. Transportation barriers, therefore, have become barriers to the fulfillment of all other domains of an integrated life[15]. Virginia's population includes approximately 314,000 working-aged citizens who are disabled, with 71 percent

[12] Multimodal System Design Guidelines. October 2013. Prepared by the Virginia Department of Rail and Transportation (DPRT). Available from: http://www.drpt.virginia.gov/media/1056/guide-for-preparing-a-multimodal-system-plan.pdf.

[13] Ibid.

[14] Ibid.

[15] Assessment of Virginia's Disability Services System: Transportation. June 2018. Prepared by: Virginia Board for People with Disabilities. Available from: https://www.vaboard.org/assessment.htmVBPD%202018%20Transportation%20Assessment.pdf.

or about 223,000 individuals able to use transit services. Specific examples from Virginia include the following:

- In Hampton Roads, Virginia, individuals with disabilities made more than 254,000 trips in 2018[16].
- If the 166 workers with disabilities surveyed riding JAUNT were unable to work and support themselves, it would cost Virginia approximately $7,000 for each person, or $1,162,000 in tax dollars to provide in-home support services.
- If these same people with disabilities who were surveyed riding JAUNT could not work and support themselves, the state would not receive tax revenue on the income earned by these individuals since they could not get to their places of employment[17].

- **Access for Seniors "Aging in Place":** aging in place coupled with the commitment and ongoing efforts to enable people with disabilities to live fully integrated lives in their communities has meant that there are more people with transportation challenges navigating communities. Federal and state policies in recent years have shifted to promote integrated competitive employment and active community engagement by people with disabilities who receive state-funded services and supports. The shift from center-based services models to dispersed to community-based service models creates new demands for transportation options to provide individuals access to employment opportunities and personalized community activities[18]. Specific examples from Virginia include the following:
  - The fastest growing age group in Virginia is the population 85 and older, which doubled in size in the past decade. About 30 percent of older Virginians do not drive. Without mobility, the elderly are more likely to become prematurely reliant on services that are costly to the individual and state[19].

10.2 Benefits to the Built Environment

The presence of transit has allowed jurisdictions to pursue dense transit-oriented development (TOD) patterns which have brought many positive health, economic, and environmental outcomes. When compared with traditional suburban development, TOD land-use patterns allow for much more compact and efficient land use which has led to reduced private vehicle use, reduced energy consumption, and reduced pollutant emissions.

[16] Virginia Transit Association. Accessed November 15, 2019. Available from: https://vatransit.com/Mobility_for_Seniors_and_Persons_with_Disabilities.

[17] Ibid.

[18] Assessment of Virginia's Disability Services System: Transportation. June 2018. Prepared by: Virginia Board for People with Disabilities. Available from: https://www.vaboard.org/assessment.htmVBPD%202018%20Transportation%20Assessment.pdf.

[19] Virginia Transit Association. Accessed November 15, 2019. Available from: https://vatransit.com/Mobility_for_Seniors_and_Persons_with_Disabilities.

This type of high-density built environment reflects an urban form that is important to ensuring sustainability and has generated economic activity by attracting residents and businesses alike. Individuals have become attracted to high-density areas due to the collocation of destinations and the ability to access other areas of a city or state quickly via transit. Businesses have become attracted to higher density areas with access to transit because they provide access to a wider client and employee base. This has led to higher demand for property in high-density neighborhoods served by transit.

In addition, the higher demand for property that can result from transit access offers the opportunity for jurisdictions to leverage influence over private development in a way that ensures outcomes that are in the public interest. The following sub-sections highlight specific built environment benefits associated with transit and provide some real examples from Virginia localities.

- **Concentrated Development:** Promoting the concentration of development, jobs, and housing has many environmental and economic benefits. The compact and efficient use of land leads to reduced private vehicle use, reduced energy consumption, and reduced pollutant emissions. In addition, higher density land-use patterns can generate economic activity by attracting residents and businesses. This can lead to higher property values in high-density neighborhoods served by transit. Specific examples from Virginia include the following:

  - Between 1960 and 2004, over 98 percent of office and retail development and 95 percent of housing additions in Arlington County have been within a ½ mile of Metrorail stations: 29.7M square feet of office space, 4M square feet of retail, and 26,500 residential units in all[20].

  - Through a combination of strategic planning and market forces, each of Arlington County's Metrorail stations has taken on a specialized function: Rosslyn, Ballston, and Crystal City serve as business centers; Court House has emerged as a governmental center; Pentagon City has become a statewide shopping center; Clarendon functions as an "urban village" with shops and restaurants; and Virginia Square has a cultural and educational focus.

  - In 2001, Arlington County increased density bonuses from 15 percent to 25 percent to encourage developers to include affordable housing units within their projects. In 2004, residential uses occupied around 55 percent of the land within ¼ mile of Court House Station in Arlington[21].

  - Downtown Norfolk has benefited from the density of the built environment, the existence of several major employers in the core, its location along the river, and its traditional role as the center of the Hampton Roads Region. Existing transit already plays a role in supporting downtown restaurants and retail establishments by enabling access to workers. The New Downtown Norfolk Transit Center links fourteen different bus routes and is within walking distance of the nearest Tide light rail station, linking the Transit Center to Eastern Virginia Medical School and the Sentara medical complex[22].

[21] Ibid.

[22] The Economic and Societal Impact of Hampton Roads Transit. June 2016. Prepared by: Economic Development Research Group. Available from: https://connecthamptonroads.com/wpcontent/themes/chr/pdf/HRT_Economic_Impact_23_June_Final.pdf

- The City of Hampton is working to create its own "urban core" at Peninsula Town Center (PTC). PTC, located within the 1,900-acre Coliseum Central Business Improvement District (CCBID), is the transformation of an old, indoor shopping mall into an updated outdoor shopping and office center. Buses provide transit service to and within the PTC. Four bus stops directly serve the shopping center. Many employees of the retail shops and businesses in the area rely on transit for commuting to work. The manager of PTC reports that retailers often ask about transit service when considering leasing space[23].

- **Incentive Zoning:** Incentive zoning is the practice of implementing zoning regulations that offer incentives to private developers in exchange for development outcomes that are in the public interest. Specific examples from Virginia include the following:

  - Arlington County has offered private developers the ability to have development projects approved through the "site plan option" which allows more flexibility in form, use, and density of development than that permitted by right in a zoning district. The majority of site plan review proposals are for hotel, residential, office, and mixed-use development in certain high-density zoning districts and typically within the Metrorail station corridors. The site plan option encourages affordable housing contributions, reduced parking ratios, transit subsidies for new tenants, improved transportation design and streetscape improvements, and public art contributions, among others[24].

  - The Rosslyn Sector Plan was completed in 1977 and provided greater freedom to private developers at higher (and hence, more profitable) densities as long as future developments conformed to the County's larger planning vision of mixed-use development based on the recently built DC Metro system (WMATA launched Metro service in 1976). Key to this strategy was the use of "incentive zoning," through which developers received density bonuses in return for including particular features, like public plazas or bus stops, in their plans. Due to this long-term development strategy, Rosslyn is now one of the state's premier locations for commercial and high-density residential uses; it contains almost 8M square feet of office space, almost 5,000 residential units, and over 2,000 hotel rooms[25].

- **Car Ownership and Parking:** Car-ownership and parking requirements are much lower in higher-density TOD areas since many residents and business patrons are able to access destinations via transit or other non-motorized transportation modes. Specific examples from Virginia include the following:

[23] Ibid.

[24] Planning for Transit-Supportive Development: A Practitioner's Guide. June 2014. Prepared by: Federal Transit Administration (FTA). Available from: https://www.transit.dot.gov/funding/funding-finance-resources/transit-oriented-development/planning-transit-supportive.

[25] Seven American TODs: Good Practices for Urban Design in Transit-Oriented Development Projects. November 2008. Prepared by: Journal of Transportation and Land Use. Accessed via https://www.jtlu.org/index.php/jtlu/article/view/67

- Among four TOD apartment projects in the DC Metro area, the ratio of cars per units was 1.04, compared to 1.30 cars per unit in similar projects in the state[26].

- According to the 2000 Census, more than 12 percent of Arlington County households do not own a vehicle, the highest rate outside the District of Columbia. The proportion of carless households is even higher in Arlington County's increasingly urban Metro corridors – approaching 20 percent[27].

- By 2000, Arlington had seen more than a 100 percent increase in individual developments since it began concentrating development around Metro stations, and although the area had planned for an 80 percent increase in traffic, the actual rise was only 16 percent. More than one third live in one the county's seven mixed-use, walkable centers along two corridors[28].

- In the City of Norfolk, parking is not free downtown, which encourages transit use even for those who have access to a vehicle[29].

- The developers of the Belmont at Freemason, a 239-unit apartment complex located by the York Street/Freemason light rail station in the City of Norfolk, noted that after building fewer parking spaces than the industry standard, two floors of their parking garage remain unoccupied at night. This indicates that the demand for vehicle ownership is lower than was anticipated. The developer estimates that 31 percent of tenants commute by transit[30].

- **Transit Stations are a Community Focal Point:** Jurisdictions have used transit stations as a community focal point to assist in generating development or redevelopment policies and this opportunity is only available because transit is present. Specific examples from Virginia include the following:

  - Clarendon's revitalization has focused on relatively smaller-scale development branching from a 1984 plan for the area articulated a vision for Clarendon as an "urban village." Using the idea of greater development around its Metro station while maintaining the strong sense of place inherent to the single-family houses and modest apartment buildings further from the station has helped Clarendon to funnel development initiatives to one focal point. Choosing to focus on the block that includes the Olmstead Building and Clarendon Metro Park without increasing density elsewhere

[26] Fiscal Impacts of Transit-Oriented Development Projects. December 2016. Prepared by: Urban Land Institute Washington/Baltimore. Available from: https://todresources.org/app/uploads/sites/2/2017/02/fiscal-impacts-report.pdf

[27] Effects of TOD on Housing, Parking, and Travel. August 2008. Prepared by: Transit Cooperative Research Program (TCRP). Available from: https://www.nap.edu/catalog/14179/effects-of-tod-on-housing-parking-and-travel

[28] Transit-oriented developments key to D.C. region's continuing economic boom. December 2017. Prepared by: Mobility Lab. Available from: https://mobilitylab.org/2017/12/05/transit-oriented-developments-key-d-c-regions-continuing-economic-boom/.

[30] The Economic and Societal Impact of Hampton Roads Transit. June 2016. Prepared by: Economic Development Research Group. Available from: https://connecthamptonroads.com/wpcontent/themes/chr/pdf/HRT_Economic_Impact_23_June_Final.pdf.

has brought ongoing commercial revitalization led by small and mid-sized businesses as well as simultaneous strengthening of the area's residential neighborhoods[31].

- Arlington County officials have taken a sophisticated approach to design standards for buildings and pedestrian infrastructure in Clarendon, as demonstrated by façade details, decorative paving, and the design of small public spaces[32].

- Ballston has experienced a rebirth and the station area is pedestrian-friendly and lively, with a mixture of residential and commercial uses. Ballston Metro Center is the signature development, combining seven stories of hotel space, eighteen stories of condominiums, a thirteen-story office building, a mall, an atrium, and a parking garage on one city block at a Metro station. Today, the area's most distinguishing characteristic is the diverse mix of uses in this area[33].

- **Transit Services as an Opportunity for Planned Investment:** Communities have also used the presence of transit as an opportunity to plan investments in public infrastructure. This has been especially true along high-capacity transit corridors that have redefined the surrounding land-uses and overall community character. Specific examples from Virginia include the following:

  - Arlington County planners understood that Metrorail provided an unprecedented opportunity to shape future growth and proceeded to introduce various strategies—targeted infrastructure improvements, incentive zoning, development proffers, permissive and by-right zoning—to entice private investments around stations[34].

  - The sector plan for Court House Station, which was adopted in 1981 and amended in 1993, designated the area as an urban government center with high-density residential and office uses. The Plaza is a pedestrian mall that can be directly accessed from the subway station below, and the streetscape creates a pedestrian-friendly environment and provides pedestrian linkages to surrounding office buildings and residential complexes.

10.3 Benefits to the Tourism Industry

Throughout the Commonwealth of Virginia, the tourism industry depends on transit to function. The presence of transit supports tourism in communities throughout the state by providing visitors with accessible and affordable travel options. This has eliminated the need for private vehicles in many circumstances, which can further reduce congestion on roadways and demand for parking[35]. In addition,

[31] Seven American TODs: Good Practices for Urban Design in Transit-Oriented Development Projects. November 2008. Prepared by: Journal of Transportation and Land Use. Accessed via https://www.jtlu.org/index.php/jtlu/article/view/67

[32] Ibid.

[33] Seven American TODs: Good Practices for Urban Design in Transit-Oriented Development Projects. November 2008. Prepared by: Journal of Transportation and Land Use. Accessed via https://www.jtlu.org/index.php/jtlu/article/view/67

[34] Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects. 2004. Prepared by: TCRP. Available from: https://www.nap.edu/read/23360/.

[35] Virginia Transit Association. Accessed September 26, 2019. Available from: https://vatransit.com/content.php?page=Benefits_for_Tourism

many tourism industry employees rely on transit modes to get to and from work. The following sub-sections highlight specific tourism benefits associated with transit and provide some examples from Virginia localities.

- **Transit Services Provide Necessary Mobility for Tourists as well as Tourism Employees:** The presence of transit services provides a needed mobility option for tourists visiting various parts of the state as well as for employees working in the tourism industry. In certain parts of the state that experience very high tourist volumes, transit plays an important role in relieving would be congestion caused by tourists. Specific examples from Virginia include the following:

  - Metropolitan Washington, which includes jurisdictions in Northern Virginia, welcomes tourists year round as the nation's capital. Tourist activity in the area spikes during special events, such as the Fourth of July, Presidential Inaugurations, the Cherry Blossom Festival, and conference events. The Fourth of July and the Cherry Blossom Festival alone bring over 500,000 visitors to the state, and without Metrorail, these visitors would not be able to get around. WMATA even runs additional services during all of these events as well as during major league baseball and soccer games to accommodate the crowds.

  - Virginia Beach is a key tourist destination with many hotels and restaurants with about 10 to 20 percent of hotel employees relying on transit to get to work. Other Virginia Beach hotels, including Gold Key PHR Hotels and Resorts, which operates the Cavalier, Hilton, Ramada, and Hilton Garden Inn, know HRT is vital to their employees as well as the business. Hotel management estimates nearly 90 percent of these support staff rely on transit to get to work[36]. Transit is especially vital to the employment base of hotels because many employees are reliant on HRT services to get to and from work.

- **Tourism Contributes to Gross State Product (GSP), Overall Spending, and Job Creation:** Tourism has become an established part of the state's economy that has brought financial benefits to the state in terms of overall economic productivity and job creation, and the presence of transit services continually supports the industry[37]. Specific examples from Virginia include the following:

  - As a whole, the tourism sector generates an average of $1.6M per day, which accounts for 5.1% of Virginia's GSP. The tourism industry is the third largest employer in Virginia, and tourist-related spending is the third largest statewide retail sales category.

  - In Hampton Roads, Virginia, visitors spent $3B at local businesses in 2014, which directly support 28,500 jobs (**Table 10-1**). Out of all domestic travelers who visited Virginia that year, 6.1 percent of spending was in Virginia Beach alone. Leisure and hospitality as a whole employ about 87,500 individuals, which is 10.3 percent of the state's employment.

  - In Downtown Norfolk, Virginia, frequent light rail and bus services bring visitors and residents to restaurants, shops, and hotels. These visitors spend money that would be spent on parking at

[36] Ibid.

[37] Virginia Transit Association. Accessed September 26, 2019. Available from: https://vatransit.com/content.php?page=Benefits_for_Tourism

commercial establishments that utilize buildable square footage for purposes that generate stronger economic activity than parking[38].

- **Transit Reduces Travel Stress:** Without having to drive, transit has enabled visitors to travel throughout the state relaxed and free from dealing with parking or traffic challenges because transit systems reach a variety of interesting destinations. Stress-free travel encourages visitors to come back and contribute further to the state's economy. Specific examples from Virginia include the following: HRT's Beach Trolley provides climate-controlled transit to and from congested Virginia Beach in the summer months. This trolley also provides guided tours through the Norfolk Naval Station to the public, which is one of the most popular tours in the area and continues to increase HRT's annual ridership[39].

  - After the success of a one-year pilot project, the City of Staunton expanded their downtown trolley system into three routes to provide more trips to and from the Shenandoah Shakespeare playhouses due to increased demand from visitors[40].

  - Colonial Williamsburg is a prime tourist destination, and the Williamsburg Area Transit Authority (WATA) carries visitors, to and from major destinations in the vicinity. This includes Colonial Williamsburg, the Williamsburg Pottery Factory, the Kimball Music Theater, Prime Outlets, the College of William and Mary, and Busch Gardens[41].

  - The Colonial Beach accessible, historic trolleys attract visitors to the "Playground of the Potomac" and provides a comfortable trip for riders with strollers, shopping bags, and beach supplies[42].

Table 10-1 Jobs Supported by Domestic Visitors to the HRT Service Area, 2014

City	Jobs	Expenditure ($M)
Virginia Beach	12,568	$1,373.15
Norfolk	6,925	$744.96
Chesapeake	3,111	$324.39
Newport News	2,836	$277.81
Hampton	2,293	$232.10
Portsmouth	779	$79.33
Total	**28,512**	**$3,031.74**

Note:

1. Source: U.S. Travel Association for the Virginia Tourism Corporation. Available from: U.S. Travel Association for the Virginia Tourism Corporation.

[38] Ibid.

[39] Ibid.

[40] Ibid.

[41] Ibid.

[42] Ibid.

10.4 Benefits to Property Values

Several studies completed throughout the state have documented that proximity to transit facilities has increased the value of nearby residential, office, industrial, and retail properties. Study findings documented in this sub-section have shown that access to transit is a positive amenity reflected in these higher values.

- **People Pay for Proximity to Transit Services:** Residents and businesses have paid more to locate near transit stops and stations than in areas with no transit access. Specific examples from Virginia include the following:
  - Proximity to Metrorail in Virginia has increased the value of residential and commercial properties because both residents and businesses are willing to pay higher prices to be located close to Metrorail stations. Residents are drawn to easier access to state and local amenities, attractions, and jobs while businesses have access to many potential employees which makes businesses competitive[43].
  - Owners around the New York Avenue Metrorail Station agreed to contribute $35M toward the cost of building the station, hoping that the Metrorail station would increase future values of their property. Since completion of the Metrorail station, assessed property values in the area have increased by nearly 300 percent, from $535M in 2001 to $2.1B in 2007[44] .
- **Proximity to Transit Services Increases Property Taxes & Land Values:** Land value has increased from being close to transit, bringing increased revenues from property taxes collected from these properties. Specific examples from Virginia include the following:
  - WMATA's 2011 study documented increases in Virginian property values from two approaches: 1) level of property tax revenues generated and 2) price of land and/or building as higher prices generate more property tax revenues. Excluding developments along WMATA's Silver Line, property within ½ mile of a Metrorail station in Virginia has increased property tax revenues by approximately $34M per year. Property values have notably increased for buildings close to Metrorail stations, but the level of the increase has varied depending on building type. Single-family residential buildings experienced a 6.8 percent increase in property values, while multi-family residential property increased by 9.4 percent, and commercial properties increased by 8.9 percent.
  - A Metropolitan Washington Council of Government's 2017 study quantified the dollar amount of value that transit brings to properties nearby transit throughout Metropolitan Washington. The study summarized that close proximity to Metrorail stations has increased property values by 7 to

[43] Contribution of Transit Services to the Northern Virginia Economy. April 2015. Prepared for: Northern Virginia Transportation Commission. Prepared by: Center for Regional Analysis George Mason University. Available from: George Mason University.

[44] Value Capture, the Dulles Rail Extension, and the Future of Transit Funding, by Jay Corbalis. Regional Coordinator of LOCUS at Smart Growth America. August 2012. Available from: https://usa.streetsblog.org/2012/08/20/value-capture-the-dulles-rail-extension-and-the-future-of-transit-funding/.

9 percent on average. Property values in total within ½ mile of Metrorail stations are worth a collective $235B, which generates a collective $3.1B per year in property taxes. Importantly, these properties represent just 4 percent of the jurisdictional acreage but they generate 28 percent of jurisdictional property taxes[45].

- Proximity to Metrorail stations in the Metropolitan Washington region has increased the price of nearby homes, and the closer a house is to a station, the higher the price. Freddie Mac used a hedonic model to statistically quantify how much of an impact a Metrorail station nearby has on home prices. The model results illustrated that there is a visible price increase for homes closer to Metrorail stations in the Washington, D.C. metro area[46].

- Homes within ¼ of a mile to a Metrorail station sold for 8.6 percent more than houses more than 1 mile away. Homes within ¼ to ½ of a mile of a Metrorail station sold for 7.5 percent more, and homes within ½ to 1 mile sold for 3.9 percent more. In terms of dollars, homes 1 mile away sold for approximately $8,640 more, which increased by about $1,636 for every 100 feet closer the house was to a Metrorail station[47].

- Many areas around the Tysons corridor have witnessed a significant effect within individual property markets. As shown in **Figure 10-1**, the entire area surrounding WMATA's new Silver Line has brought steady increases to Northern Virginia property values[48].

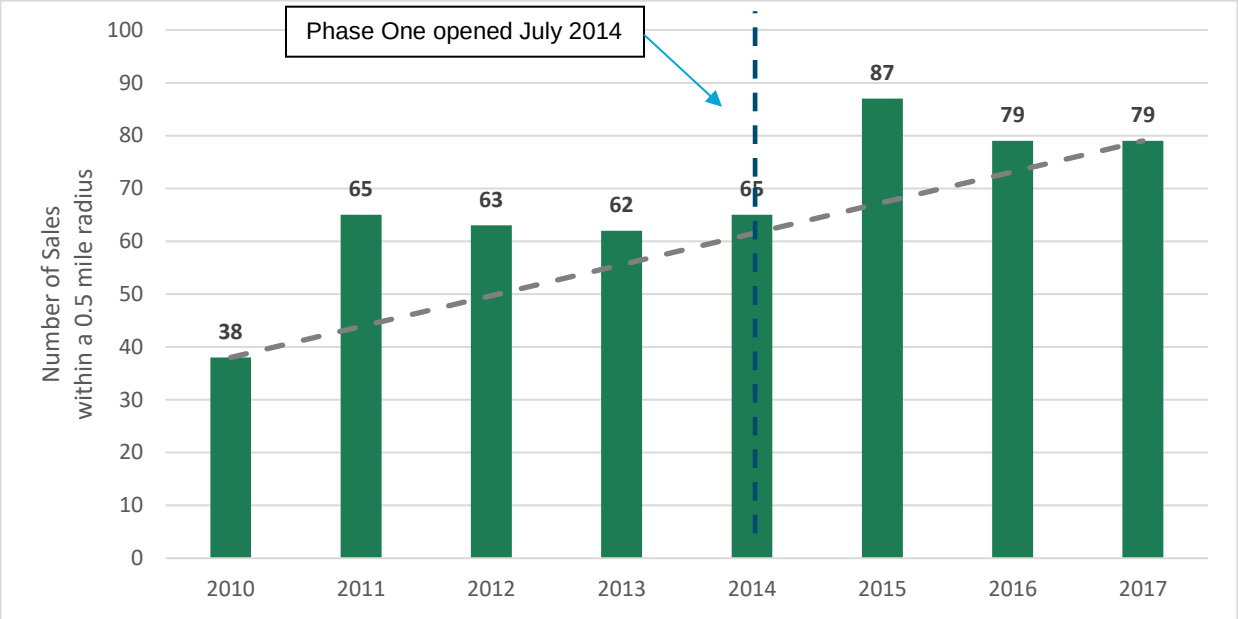
[45] The Value of Metrorail and Virginia Railway Express to the Commonwealth of Virginia. Summary Report. September 2017. Prepared by: Northern Virginia Transportation Commission. Available from: Northern Virginia Transportation Commission.

[46] Proximity to a Metro Rail Station and Its Impact on Washington, DC Metropolitan House Prices: Amenity or Not? October 2019. Prepared by: Freddie Mac. Available from: http://www.freddiemac.com/research/insight/20191002_metro_station_impact.page.

[47] Ibid.

[48] Effects of Transit Development Projects on CRE, May 2018, Prepared by: Reonomy. Available from: https://www.reonomy.com/blog/post/effect-of-transit-development-projects-on-cre.

Figure 10-1 Washington, D.C. Silver Line Nearby Property Sales, 2010-2017



Notes:

1. Effects of Transit Development Projects on CRE, May 2018, Prepared by: Reonomy. Available from: https://www.reonomy.com/blog/post/effect-of-transit-development-projects-on-cre.
2. 41 percent increase between 2010 and 2017

10.5 Benefits to Fiscal Gains

Counties and cities have experienced fiscal gains in areas that are serviced by transit. The taxes paid by developers and the private fees (i.e., value capture) collected in areas close to transit are often higher than in areas that are not served by transit. These funds can be used by localities to fund improvements to municipal infrastructure, including public facilities (libraries, fire and police stations, schools, etc.) and recreational facilities (parks, bicycle paths, community centers, etc.). By capitalizing on transit, municipalities have incentivized developers to focus on the parcels around transit while receiving more revenue from those developments in the long run than they would receive from similar developments in auto-centric areas.

- **Transit Services and TOD Generate Larger Fiscal Gains:** TOD corridors with robust transit services have generated a larger percentage of county and city revenues in Northern Virginia than auto-centric developments. This is mostly due to land being used more efficiently. In these areas, low value land-uses to accommodate vehicles, like parking lots, are not nearly as ubiquitous as they are in other places. In TOD development patterns, land has been developed into economic generators like residences, shops, and offices. Furthermore, municipalities have saved public money from being spent on providing numerous commuter parking spaces. Specific examples from Virginia include the following:

  - A precursor to TOD, the private development project of Rosslyn Metro Center was initiated in 1973, three years before the Metrorail system opened. By 2003, there were 52 joint development

projects with a market value of $4B, which delivered some $6M in annual revenues to WMATA. In addition, these new developments generated an estimated 50,000 new transit riders and over 25,000 jobs[49].

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[49] Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects. 2004. Prepared by: TCRP. Available from: https://www.nap.edu/read/23360/

- **Table** 10-2 illustrates the net fiscal impact for four TOD projects: the Shelby in Fairfax County, VA.; the Alaire in the City of Rockville, MD.; the Fitzgerald in the City of Baltimore, MD.; and the Village at Odenton Station in Anne Arundel County, MD.

- **Table** 10-2 illustrates the net fiscal impact if the same four TOD projects were developed as non-TOD projects. Numbers shown in both tables are annual estimated revenue and expenditures to have been generated if these four projects had been fully built-out and occupied in FY2014. Revenues and expenditures are based on each jurisdiction's CAFR.

- In the Rosslyn Ballston TOD Corridor in Arlington, Virginia, eight percent of county land generates 33 percent of county revenues as of 2014, allowing Arlington to have the lowest property tax in Northern Virginia. In addition, 50 percent of residents take transit to work and 73 percent walk to stations[50]. So many transit riders access rail stations on foot which saves the county WMATA from having to provide long-term commuter parking. Additionally, parking lots near transit stations have all been developed[51].

- The Shelby, a 240-unit apartment building in Fairfax County, Virginia, is located one-half mile from the Huntington Metrorail station in a TOD neighborhood that encourages walking to the station and use of public buses. Revenues generated from tax and nontax sources surpass the cost to Fairfax County; as shown in

[50] Encouraging Transit Oriented Development: Case Studies That Work. May 2014. Prepared by: EPA. Available from: https://www.epa.gov/sites/production/files/2014-05/documents/phoenix-sgia-case-studies.pdf

[51] Effects of TOD on Housing, Parking, and Travel. August 2008. Prepared by: Transit Cooperative Research Program (TCRP). Available from: https://www.nap.edu/catalog/14179/effects-of-tod-on-housing-parking-and-travel

- **Table** 10-2**,** the building provides an estimated net annual fiscal benefit for the county of $364,946[52].

- Capitalizing on the Metro system has allowed for greater densities in Rosslyn, Virginia, through TOD incentives and zoning and thus higher returns from commercial property taxes because land has been developed for transit use and dense development instead of thoroughfares and parking[53].

- Survey results have shown that around half of the shoppers and customers going to the Pentagon City Fashion Center in Arlington, Virginia, arrive by Metrorail. Many are federal workers who come from Washington's Federal Triangle area, and every purchase generates tax revenues from sales taxes, which collectively equates several million dollars per year.

- Overall, Arlington County's Rosslyn-Ballston TOD corridor has been credited with generating 32.8 percent of the County's real-estate tax revenue, even though it makes up just 7.6 percent of the County's land area[54].

- Among nearly 10,000 apartments in 42 TOD and non-TOD projects in Virginia and Maryland, TOD units generated a lower demand for public services per unit on local governments and schools than non-TOD apartment units. In FY 2014, TOD project apartments generated between $1.13 and $2.20 in tax and non-tax revenues for their respective jurisdictions for every $1 spent on public services for the residents and employees[55].

- The additional 85,000 households and 130,500 jobs that Metrorail and Virginia Railway Express (VRE) make possible in Northern Virginia generate over $600M (just over 3 percent of general fund revenues) each year in sales and income tax revenues that flow to Richmond. For every dollar the state invests in Metrorail and VRE, it receives $2.50 in return. This $600M is more than Virginia's annual general fund expenditures on state colleges and universities, around $316M, and state police, about $266M[56].

[52] Fiscal Impacts of Transit-Oriented Development Projects. December 2016. Prepared by: Urban Land Institute Washington/Baltimore. Available from: https://todresources.org/app/uploads/sites/2/2017/02/fiscal-impacts-report.pdf

[53] Seven American TODs: Good Practices for Urban Design in Transit-Oriented Development Projects. November 2008. Prepared by: Journal of Transportation and Land Use. Accessed via https://www.jtlu.org/index.php/jtlu/article/view/67

[54] Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects. 2004. Prepared by: TCRP. Available from: https://www.nap.edu/read/23360/

[55] Fiscal Impacts of Transit-Oriented Development Projects. December 2016. Prepared by: Urban Land Institute Washington/Baltimore. Available from: https://todresources.org/app/uploads/sites/2/2017/02/fiscal-impacts-report.pdf

[56] The Value of Metrorail and Virginia Railway Express to the Commonwealth of Virginia: Technical Memorandum. January 2018. Prepared by: Northern Virginia Transit Commission (NVTC). Available from: http://www.novatransit.org/uploads/studiesarchive/2018%20Value%20of%20Transit%20Technical%20Report%20-%20Final.pdf.

- The expansion of light rail through Virginia Beach Town Center will help Virginia Beach use TOD to boost the tax base of Virginia Beach through increased property values, increased rents, business license fees, and sales taxes, again saving public money[57].

[57] The Economic and Societal Impact of Hampton Roads Transit. June 2016. Prepared by: Economic Development Research Group. Available from: https://connecthamptonroads.com/wpcontent/themes/chr/pdf/HRT_Economic_Impact_23_June_Final.pdf

Table 10-2 Net Fiscal Impact of Four TOD Projects in Virginia and Maryland, FY2014

Aggregate Residential	The Shelby	The Alaire	The Fitzgerald	The Village at Odenton Station
Annual Revenues Generated	$ 1,117,400	$ 371,660	$ 1,531,898	$ 705,321
Annual Expenditures Demanded	$ 752,454	$ 333,684	$ 707,891	$ 590,185
Annual Revenue Surplus (Deficit)	$ 364,946	$ 37,976	$ 824,007	$ 115,136
Aggregate Non-Residential	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 0	$ 17,157	$ 194,147	$ 111,591
Annual Expenditures Demanded	$ 0	$ 9,265	$ 77,101	$ 69,271
Annual Revenue Surplus (Deficit)	$ 0	$ 7,892	$ 117,046	$ 42,320
Total All Land Uses	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 1,117,400	$ 388,817	$ 1,726,045	$ 816,912
Annual Expenditures Demanded	$ 752,454	$ 342,949	$ 784,992	$ 659,456
Annual Revenue Surplus (Deficit)	$ 364,946	$ 45,868	$ 941,053	$ 157,456
Per-Unit Residential Only	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 4,656	$ 1,332	$ 5,571	$ 3,001
Annual Expenditures Demanded	$ 3,135	$ 1,196	$ 2,574	$ 2,511
Annual Revenue Surplus (Deficit)	$ 1,521	$ 136	$ 2,997	$ 490

Notes:

1. Source: Urban Analytics, Inc., accessed in Fiscal Impacts of Transit-Oriented Development Projects, December 2016. Prepared by: Urban Land Institute Washington/Baltimore. https://todresources.org/app/uploads/sites/2/2017/02/fiscal-impacts-report.pdf
2. These are the revenue and expenditure figures that are estimated to have been generated (on an annual basis) had the four TOD projects selected for analysis (i.e., The Shelby project in Fairfax County, VA; The Alaire project in the City of Rockville, MD; The Fitzgerald project in the City of Baltimore, MD; and The Village at Odenton Station project in Anne Arundel County, MD.) been fully built-out and occupied in FY 2014.

Table 10-3 Fiscal Impact of Four TOD Projects in Virginia and Maryland if They Were Non-TOD Projects, FY2014

Aggregate Residential	The Shelby	The Alaire	The Fitzgerald	The Village at Odenton Station
Annual Revenues Generated	$ 1,136,105	$ 458,304	$ 1,933,565	$ 881,998
Annual Expenditures Demanded	$ 952,961	$ 498,590	$ 1,502,500	$ 1,224,047
Annual Revenue Surplus (Deficit)	$ 183,144	($ 40,286)	$ 431,065	($ 342,049)
Aggregate Non-Residential	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 0	$ 17,157	$ 194,147	$ 111,591
Annual Expenditures Demanded	$ 0	$ 9,265	$ 77,101	$ 69,271
Annual Revenue Surplus (Deficit)	$ 0	$ 7,892	$ 117,046	$ 42,320
Total All Land Uses	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 1,136,105	$ 475,461	$ 2,127,712	$ 993,589
Annual Expenditures Demanded	$ 952,961	$ 507,855	$ 1,579,601	$ 1,293,318
Annual Revenue Surplus (Deficit)	$ 183,144	($ 32,394)	$ 548,111	($ 299,729)
Per-Unit Residential Only	**The Shelby**	**The Alaire**	**The Fitzgerald**	**The Village at Odenton Station**
Annual Revenues Generated	$ 4,734	$ 1,643	$ 7,031	$ 3,753
Annual Expenditures Demanded	$ 3,971	$ 1,787	$ 5,464	$ 5,208
Annual Revenue Surplus (Deficit)	$ 763	($ 144)	$ 1,567	($ 1,455)

Notes:

1. Source: Urban Analytics, Inc., accessed in Fiscal Impacts of Transit-Oriented Development Projects, December 2016. Prepared by: Urban Land Institute Washington/Baltimore. https://todresources.org/app/uploads/sites/2/2017/02/fiscal-impacts-report.pdf
2. These are the revenue and expenditure figures that are estimated to have been generated (on an annual basis) if the four projects selected for analysis (i.e., The Shelby project in Fairfax County, VA; The Alaire project in the City of Rockville, MD; The Fitzgerald project in the City of Baltimore, MD; and The Village at Odenton Station project in Anne Arundel County, MD.) were non-TOD projects and had been fully built-out and occupied in FY 2014.

11.0 Total Economic Impacts of Transit in Virginia

This section summarizes the annual monetized expected direct economic benefits and corresponding total economic impacts generated by transit services statewide as well as from the study's specific sub-areas: NoVA Urban Areas, Other Urban Areas, and Rural Areas (with transit services). This includes estimations of the benefit-cost ratio (BCR) of transit, the return on investment (ROI) associated with transit spending, as well as the implicit jobs multiplier from transit service operations and services in the state. The section concludes with summarizing remarks based on the findings of the study.

11.1 Summary of Monetized Direct Economic Benefits

The direct public benefits attributed to transit in Virginia are summarized in**Table 11-1** and **Table 11-2**. The methodology used to estimate these results are presented in **Sections 5** through **9** of this document. The total monetized benefits attributed to the presence of transit is equal to roughly $2.5B. Compared with a scenario in which transit did not exist, the following benefits were calculated:

- **Congestion Relief Benefits –** The presence and use of transit in Virginia saved drivers $615.1M in travel time costs and $66.4M in delay costs.
- **Increased/Affordable Mobility Benefits –** The use of transit in Virginia saved $297.4M in transportation costs to transit riders. The presence of these services also allowed dependent riders who would have to forgo their commute and work-related trips in the absence of transit to make $1.5B in labor income.
- **Other Community Impacts –** Transit use in Virginia saved $59.6M in vehicle crash costs, $27.5M in fuel consumption costs (1.3 million gallons of fuel), and $400K in pavement maintenance costs.

Table 11-1 Direct Monetized Benefits Attributed to Transit in Virginia, FY2018

Benefit Type (w/ Section Reference)	Total (2018$)
Congestion Relief: Travel Time Savings (Section 5)	$615,154,127
Congestion Relief: Avoided Cost of Delays (Section 5)	$66,337,036
Mobility: Net Expenditure Value / Vehicle Ownership Cost Savings (Section 7)	$297,383,645
Mobility: Forgone Employment Benefit (Section 7)	$1,452,340,933
Other: Net Traffic Crash Cost Savings (Section 6)	$59,637,154
Other: Net Emission Cost Savings (Section 8)	$12,826,358
Other: Net Fuel Consumption Savings (Section 8)	$27,502,467
Other: Net Pavement Maintenance Cost Savings (Section 9)	$408,466
Total Direct Economic Benefits =	**$2,531,590,186**

Notes:

1. The net expenditure value benefit is the reduction in vehicle ownership costs to those who use transit in place of alternative motorized modes to satisfy their transportation needs.
2. The forgone employment benefit is the income lost by transit dependent riders who would have to forgo their commute and work-related business trips in the absence of transit.

Table 11-2 Direct Monetized Benefits Attributed to Transit by Sub-Region, FY2018

Benefit Type	NoVA (2018$M)	Urban Areas (2018$M)	Rural Areas (2018$M)	Total (2018$M)
Congestion Relief: Travel Time Savings	$473.0	$137.7	$6.4	$615.1
Congestion Relief: Avoided Cost of Delays	$50.8	$14.9	$0.7	$66.4
Mobility: Net Vehicle Ownership Cost Savings	$227.7	$66.6	$3.1	$297.4
Mobility: Forgone Employment Benefit	$1,112.0	$325.2	$15.2	$1,452.3
Other: Net Traffic Crash Cost Savings	$45.7	$13.3	$0.6	$59.6
Other: Net Emission Cost Savings	$9.8	$2.9	$0.1	$12.8
Other: Net Fuel Consumption Savings	$21.0	$6.1	$0.3	$27.5
Other: Net Pavement Maintenance Cost Savings	$0.3	$0.09	$0.01	$0.4
Total Direct Economic Benefits	**$1,940.30**	**$566.79**	**$26.41**	**$2,531.50**

Notes:

1. The net expenditure value benefit is the reduction in transportation costs to those who use transit in place of alternative motorized modes to satisfy their transportation needs.
2. The forgone employment benefit is the income lost by transit dependent riders who would have to forgo their commute and work-related business trips in the absence of transit.

11.2 Summary of Total Expected Economic Impacts

The IMPLAN economic model was used to calculate the total economic impacts of transit in the Commonwealth of Virginia as a whole, and within the sub-regional designations of this study. In order to run the model, the following direct economic impacts were converted to model inputs: capital and operating (payroll and non-payroll) spending by transit agencies, travel time savings and avoided cost of delays accruing to trips with economic value, and the net expenditure value and forgone employment benefits in FY2018. **Appendix A** describes IMPLAN and related terminology in greater detail.

The indirect impacts and induced effects generated by expected direct economic benefits listed in **Table 11-1** were modeled using IMPLAN, which generated estimates of the total economic impacts on full-time jobs, personal income, value added (GSP), and-tax revenue collected. The total (direct, indirect, and induced) economic benefits transit services have generated statewide are presented by impact source in **Table 11-3**.

Total Economic Impact

The total economic impacts of the presence and use of transit in Virginia included the creation of 28,940 full-time jobs, which generated $1.9B in labor income, leading to an increase of $3.4B in GSP, and bringing back $596M in tax revenue to state and local coffers. These economic impacts were generated from three sources of spending and direct benefits:

- **Enterprise Spending –** Transit agency spending of $1.5B in FY2018, supported the creation of 18,280 full-time jobs, generating $1.3B in labor income, $2.3B in GSP, and $373M in tax revenue

- **Congestion Relief Impacts –** Travel time and delay cost savings accruing to commute and business trips, which was valued at $681.5M in FY2018, support the creation of 1,445 full-time jobs. These jobs generated $81M in personal income, $149M in GSP, and $30M in tax revenue.

- **Increased/ Affordable Mobility Impacts –** The savings in transportation cost accruing to transit riders ($297M in FY2018) and the employment income generated by riders who depend on transit to get to work ($1.4B in FY2018) supported the creation of 9,215 full-time jobs. These jobs generated $496M in labor income, $951M in GSP, and $193M in tax revenue.

Table 11-3 Total Economic Impacts Generated by Transit in Virginia by Impact Source, FY2018

Impact Source	Employment (Full-Time Jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
Enterprise Effects	18,280	$1,297	$2,338	$373
Congestion Relief	1,445	$81	$149	$30
Increased/Affordable Mobility	9,215	$496	$951	$193
Total Economic Impact =	**28,940**	**$1,873**	**$3,438**	**$596**

Notes:

1. The total economic benefits are estimated using the IMPLAN economic model for Virginia.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN.

Regional Results

This study also calculated the share of the economic benefits and impacts generated by public transportation spending and use in the following sub-regions (see map shown in **Figure 3-2**) throughout the state:

- **Northern Virginia (NoVA) Urban Areas:** Urbanized jurisdictions in the Metropolitan Washington Region;
- **Other Urban Areas:** VA jurisdictions where more than 50% of the population lives in areas classified as urban; and
- **Rural Areas**: VA jurisdictions where more than 50% of the population lives in areas classified as rural.

The total benefits within NoVA, Other Urban Areas, and Rural Areas (with transit services) are summarized by impact source in **Table 11-4**, **Table 11-5**, and **Table 11-6.** Total benefits statewide as well as from the study's specific sub-areas are summarized in **Table 11-7**.

Northern Virginia

The majority of the monetized benefits and economic impacts found in this study are generated in the NoVA sub-region of the state due to the outsized presence of transit systems serving this area, as well as access to Washington, DC. Transit services in NoVA include the full extent of the WMATA Metrorail and Metrobus systems in Virginia, the VRE commuter rail service, and multiple large local bus systems operating within and between NoVA jurisdictions.

As a major metropolitan area as well as the Nation's Capital, Washington, DC, is an established generator of jobs, tourism, business, and government which are natural trip generators. Furthermore, the prolonged presence of WMATA's Metrorail has fostered dense development in NoVA and the Urban Areas for a longer period of time than development around transit elsewhere in the state because of this robust transit service to and from Washington, DC. This has made travel easier to and from jobs as well as recreational destinations, generating economic output.

The grand majority of all transit ridership, person vehicle miles and hours, and revenue miles and hours provided in the state in FY2018 occurred in this area. This study found the following specific results for the NoVA region:

- The presence of transit in the NoVA region generated nearly $2.0B in direct benefits to the state.
  - The majority of monetized benefits in this region came from providing access to low income earners, enabling them to earn over $1.1B that would have been forgone if transit did not exist.
  - The NoVA region has the worst congestion issues in the state, but it would be even worse if transit was not available. Congestion relief benefits attributed to transit in this region accounted for over $523M between travel time savings ($473M) and cost of delay savings ($50M).
- The presence of transit services and agency spending in NoVA jurisdictions created 22,088 full-time jobs, which generates $1.4B in labor income, $2.6B in GSP, and $453M in tax revenue.

Table 11-4 Total Economic Impacts Generated by Transit Services in NoVA by Impact Source, FY2018

Impact Source	Employment (Full-Time jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
Enterprise Effects	13,690	$963	$1,709	$275
Congestion Relief	1,143	$66	$122	$25
Increased/Affordable Mobility	7,255	$406	$773	$153
Total Economic Impact =	**22,088**	**$1,434**	**$2,604**	**$453**

Note:

1. The total economic benefits are estimated using the IMPLAN economic model for NoVA.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

Other Urban Areas

The Other Urban Areas sub-region includes a the large metropolitan areas of Hampton Roads, Richmond, and Roanoke, as well as a diverse collection of small to mid-sized cities throughout the state, and the urbanized areas surrounding them. These areas are served by public transportation agencies that mostly operate fixed-route bus transit and complimentary paratransit services. A few Other Urban jurisdictions in the central part of the state are also served by the VRE commuter rail system, the Hampton Roads region is served by limited light rail and ferry services, and the Richmond area is served by a new BRT system.

In general, the availability of transit services in the jurisdictions that make up this sub-region is much lower than the NoVA urban areas, and patronage of these services is also lower. These agencies, however, still provide vital connections to individuals throughout the state. This study found the following specific results for the Other Urban Areas sub-region:

- The presence of transit in Other Urban Areas generated over $576M in direct benefits to the state.
  - Providing access to low income earners enabled them to earn over $325M that would have been forgone if transit did not exist, which was the largest monetized benefit found.
  - In addition, travel time savings in Other Urban Areas accounted for $138M in savings.
- The presence of transit services and agency spending in Other Urban Area jurisdictions created 6,464 full-time jobs, which generated $408M in labor income, $791B in GSP, and $133M in tax revenue.

Table 11-5 Total Economic Impacts Generated by Transit Services in Urban Areas by Impact Source, FY2018

Impact Source	Employment (Full-Time jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
Enterprise Effects	4,260	$305	$589	$88
Congestion Relief	294	$14	$28	$6
Increased/Affordable Mobility	1,910	$89	$174	$38
Total Economic Impact =	**6,464**	**$408**	**$791**	**$133**

Note:

1. The total economic benefits are estimated using the IMPLAN economic model for VA urban areas, excluding NoVA.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN.

Rural Areas

The Rural Areas sub-region includes all counties throughout the state in which more than 50% of the population lives in areas that are considered to be rural. These low density "mostly rural" and "completely rural" communities are mostly supported by either deviated fixed route or demand response bus services that allow transit agencies the flexibility to alter routes to meet riders' demands.

The built environment in most of these communities is not designed to support population or job density high enough to justify robust transit services, so many of the agencies in these jurisdictions provide "life line" service to individuals that have no other viable means of transportation. This means that service frequencies for fixed route service and overall ridership are quite low compared with urban areas. This study found that the economic benefits and impacts associated with transit services in these areas is also low compared with NoVA and other Urban Areas:

- The presence of transit in the Rural Areas sub-region generated nearly $27M in direct benefits to the state.
  - Providing vital access to low income earners enabled them to earn over $15M that would have been forgone if transit did not exist.
  - Travel time savings in Rural Areas accounted for $6.4M in savings.
- The presence of transit services and agency spending in Rural Area jurisdictions created 388 full-time jobs, which generated $31M in labor income, $43B in GSP, and $11M in tax revenue.

Table 11-6 Total Economic Impacts Generated by Transit Services in Rural by Impact Source, FY2018

Impact Source	Employment (Full-Time jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
Enterprise Effects	330	$29.47	$39.29	$9.82
Congestion Relief	8	$0.29	$0.59	$0.10
Increased/Affordable Mobility	50	$1.67	$3.54	$0.98
Total Economic Impact =	**388**	**$31.43**	**$43.42**	**$10.90**

Note:

1. The total economic benefits are estimated using the IMPLAN economic model for VA rural areas.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

Table 11-7 Total Economic Impacts Generated by Transit Services Statewide and by Sub-Region, FY2018

Study Area	Employment (Full-Time jobs)	Labor Income (2018$M)	GSP (2018$M)	Tax Revenue (2018$M)
NoVA Urban Areas	22,088	$1,434	$2,604	$453
Other Urban Areas	6,464	$408	$791	$133
Rural Areas (w/ Transit services)	388	$31.43	$43.42	$10.90
Commonwealth of Virginia	**28,940**	**$1,873**	**$3,438**	**$596**

Note:

1. The total economic benefits are estimated using the IMPLAN economic models for the study areas.
2. The number of jobs estimated by IMPLAN are converted to full-time jobs by using the conversion factors provided by IMPLAN Group LLC.

11.3 Economic Justification Metrics

To determine the relative impact of a public or private investment, economic justification metrics are often used to help conceptualized benefits and returns compared with costs. Three metrics that are relevant to this transit analysis include return on investment (ROI), benefit-cost ratio (BCR), and the implicit jobs multiplier of transit investments in Virginia. The summary of the economic justification measures is shown in **Table 11-8**.

These metrics were estimated by comparing the total public investment in transit to the total monetized economic benefits and economic impacts of transit in FY2018. Public investments were limited to the total local, state, and federal government dollars used to support transit, and do not include private revenues such as fares, advertising sales, and other user fees. The results of these estimations were as follows:

- **The Return on Investment (ROI) of Transit Spending was 2.86**: Every dollar of public investment in transit generated $2.86 in economic activity (GSP) statewide.
- **The Benefit/Cost Ratio (BCR) of Transit Spending was 2.11**: Every dollar of public investment in transit yielded an additional $2.11 in direct economic benefits statewide.
- **The Jobs Multiplier of the Transit Industry was 4.10**: Every direct or contracted job within the public passenger transportation sector supported 4.1 additional jobs in the state.

Table 11-8 Economic Justification Metrics for Public Investments in Transit in Virginia, FY2018 (Dollars in Millions; Jobs and Metrics in Actual Values)

Metric	Value
Return on Investment (Impact on GSP/Total Public Cost)	**2.86**
Total Impact on Gross State Product (GSP)	*$3,437.70*
Total Public Cost (Total Costs - Total Other Revenue)	*$1,202.00*
Benefit/Cost Ratio (Monetized benefits/ Total Public Cost)	**2.11**
Monetized Direct Benefits	*$2,531.60*
Total Public Cost (Total Costs - Total Other Revenue)	*$1,202.00*
Total Costs (Expenses)	**$1,548.00**
Capital Expenses	*$483.20*
Non-Payroll Operating Expenses	*$486.10*
Payroll Operating Expenses	*$578.70*
Total Other Revenues (Fares, Advertising, Other)	**$345.80**
Total Public Cost (Total Costs - Total Other Revenue)	**$1,202.00**
Jobs Multiplier (Total Jobs Created/ Direct Jobs Created)	**4.10**
Direct Jobs Created	*7,025*
Total Jobs Created	*28,940*

Note:

1. Total other revenues come from the *Operating Assistance Applications* (FY20- 2018 Actuals) file provided by DRPT.

A summary of the economic justification measures by sub-region is shown in **Table 11-9**. Consistent with the economic impacts, the Northern Virginia sub-region has the highest return-on-investment. The Northern Virginia region outperforms the state average for ROI and BCR. Although the BCR are lower for other urban areas and rural areas, the BCR value is positive for all sub-regions, indicating that transit benefits are greater than public costs.

Table 11-9 Economic Justification Metrics for Public Investments in Transit by Sub-Region, FY2018 (Dollars in Millions)

Metric	NoVA Urban Areas	Other Urban Areas	Rural Areas	Total Statewide
Return on Investment (Impact on GSP/Total Public Cost)	**3.02**	**2.51**	**1.68**	**2.86**
Total Impact on Gross State Product (GSP)	$2,604.0	$791.0	$43.0	$3,437.70
Total Public Cost (Total Costs - Total Other Revenue)	$861.1	$315.3	$25.8	$1,202.00
Benefit/Cost Ratio (Monetized benefits/ Total Public Cost)	**2.29**	**1.83**	**1.04**	**2.11**
Monetized Direct Benefits	$1,972.1	$576.7	$26.9	$2,531.60
Total Public Cost (Total Costs - Total Other Revenue)	$861.1	$315.3	$25.8	$1,202.00

11.4 The Value of Transit to Virginia

Continued support for transit services in Virginia is important because transit services improve quality of life for everyone, add value to local communities, and promote overall economic prosperity.

- **Transit Services Improve Quality of Life:** Transit service in Virginia improves the quality of life for all residents regardless of whether they use transit modes or not. Transit services help localities maximize use of their existing infrastructure by increasing overall person-throughput on available roadway capacity. Given the combination of increased traffic levels and expanded transit services, transit use has played a greater role in controlling roadway congestion, which in turn reduces travel delays and results in cost savings to all taxpayers. Transit services also lower costs associated with air pollution and traffic accidents, generating statewide environmental and safety benefits. Transit services in rural communities provides access to jobs and health services, particularly for those with limited ability to drive.

- **Transit Services Add Value to the Community:** The benefits of transit in Virginia reach beyond quality of life and economic prosperity. Proximity to transit facilities has increased the value of nearby residential, commercial, and retail properties. Transit agencies have contributed directly to the statewide economy by generating employment as well as spending on goods and services from Virginia companies.

- **Transit Services Promote Economic Prosperity:** Transit services in Virginia have allowed employers to access a wider labor pool and workers in turn have more access to employment opportunities. Transit services have enabled people who do not drive or do not own a car to join the workforce, which has helped to reduce government spending on social services. Expanded services

have helped workers get new and better jobs by providing transit-dependent individuals with greater access to employment opportunities. Easily accessible transit has become attractive to employees and customers, which has enabled businesses to retain good workers.

Greater densities at transit stations generate a larger market for employees, residents, and customers with access to transit services. Similarly, high transit ridership generates an incentive for businesses, services, and residents to locate at greater densities near stations. Amazon, the largest global on-line retailer, has made plans to build its second headquarters (HQ2) in Crystal City and Pentagon City in part because of access to transit services[58]. Workers working in an urban environment spend less time in their cars, which will help Amazon achieve more than 50 percent mode share for non-auto commutes as promised for HQ2[59].

The ability to stimulate concentrations of employment near transit stations and reverse trends of job sprawl partially depends on leveraging the natural propensity for certain industries to concentrate near transit services. Some industries may benefit from concentrating near transit services because they can take advantage of access to a larger labor pool. Investments in transit services may increase economic productivity by enabling the growth and densification of cities, downtowns or industrial clusters, which is useful to understand in allocating funding to maximize the benefits of transit investments.

[58] https://www.businessinsider.com/amazon-hq2-crystal-city-report-background-2018-11#the-area-is-around-two-miles-away-from-ronald-reagan-national-airport-2

[59] https://www.smartergrowth.net/news-parent/press-releases/csg-testimony-re-amazon-affordable-housing/

Appendix A. Virginia IMPLAN Model

The IMPLAN economic model for Virginia was used to estimate the direct, indirect, and induced benefits generated by transit services in the state in FY2018.

The economic data for IMPLAN includes 536 industry sectors, which are classified on the basis of the primary commodity or service produced. Corresponding data sets are also produced for each county in Virginia, allowing for analysis at the county level and for geographic aggregations such as clusters of contiguous counties.

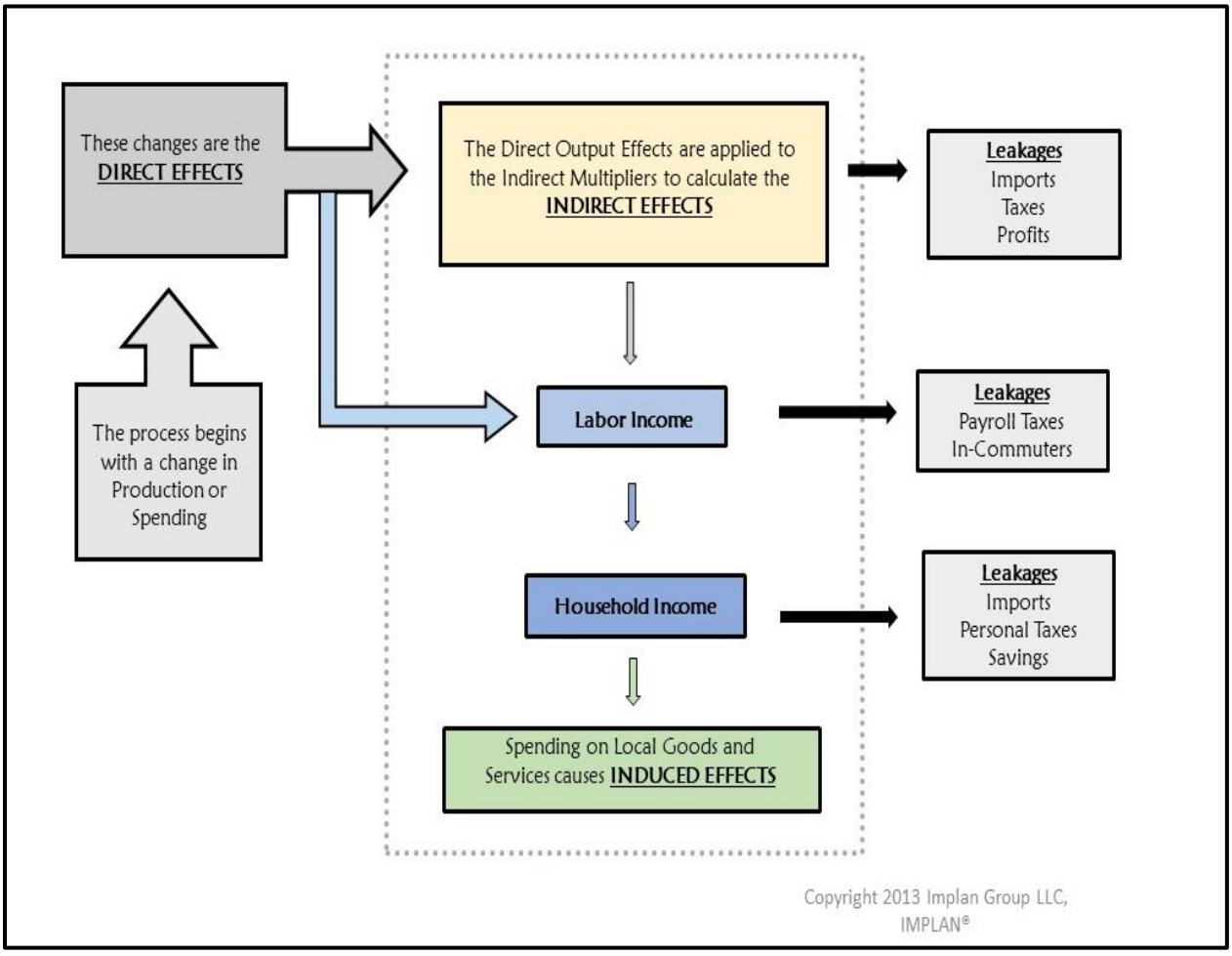
The model applied multiplier effects to changes in final demand (end users) for each industry within the defined economic area that are attributable to a change in expenditures in one or more industries (**Figure A.1**). Multipliers estimate three components of total change in final demand within the defined area:

- **Direct impacts** – Economic benefits that are directly derived from the presence of transit (e.g. transit agency employment).
- **Indirect impacts –** Industry-to-industry interactions in response to the changes in transportation investments, costs, and demands (e.g. employment with companies that support the transit industry).
- **Induced effects –** Changes in household spending as total income and population adjust based on the direct impacts of transit investment. (e.g. the wages of transit employees lead to increased retail sales).

The wider economic impacts on jobs (employment), labor income, Gross State Product (GSP), and tax revenue, are defined as follows:

- **Employment (Jobs) –** This is the estimate of the number of jobs (full and part time) by place of work generated by an investment. Full-time and part-time jobs were given equal weight in this analysis.
- **Labor Income –** This is a measure of wages and benefits associated with the additional employment generated.
- **Gross State Product (GSP) –** This captures the additional value created in the production process which includes employee compensation (labor income), proprietor income (i.e., payments received by self-employed individuals as income), other income types, and indirect business taxes.
- **Tax Revenue –** This is the increase in property and sales tax revenue to the local government, as well as changes in income tax revenues and taxes on production and imports for the federal and state government, that are realized when local resident and business activity changes.

Figure A-1 Impact Calculation Process



Source: IMPLAN Group LLC.