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# Benefits of State-Supported Passenger Rail Services in North Carolina



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## EXECUTIVE SUMMARY

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Railroads are an important part of the transportation system, enabling a cost-effective movement of goods and people to various destinations. Rail services can generally be broken into these two categories: freight service (movement of goods) and passenger service (movement of people). The North Carolina Railroad's freight services move approximately 11.4 million tons of freight annually, which support additional economic activity estimated at \$794 million in statewide sales.<sup>1</sup> In total, freight rail networks contribute to approximately \$1.75 billion in direct economic impacts per year for North Carolina due to shipper cost savings, pavement cost savings, and congestion cost savings.<sup>2</sup> In addition to freight, North Carolina's passenger rail services have a substantial impact on North Carolina's economy. This study focuses on passenger services and the economic contribution they provide.

North Carolina's passenger rail system supported approximately 487,000 annual passengers who traveled over 113 million miles on the Piedmont and Carolinian services in 2014.<sup>3</sup> These services benefit both passenger rail customers and the state's overall economy. In the absence of rail service, customers would be required to travel using other (often more-costly) modes or forego their intended trip altogether.

This study estimates the benefits North Carolina's Piedmont and Carolinian rail services provide to its users and to the state's economy. These benefits are detailed as *transportation cost savings* (benefits realized by traveling via passenger rail instead of by alternative modes), *affordable mobility benefits* (benefits derived from trips that would be foregone in the absence of rail service), and *expenditure-related economic contribution* (impacts to the state's economy resulting from expenditures related to rail operations and capital expenditures). Based on the findings in this study, on annual basis, North Carolina's passenger rail services contribute to 430 jobs, \$20.1 million in earned wages, \$30.6 million in gross state product, and \$47.4 million in benefits rail passengers receive from taking the train instead of other modes of travel.

*Transportation cost savings* and *affordable mobility benefits* are experienced by rail passengers. A rail passenger realizes *transportation cost savings* through a number of cost saving components by taking the train in lieu of another mode. These cost saving components are as follows:

- Vehicle operating cost savings
- Travel time and productivity savings
- Collision cost savings
- Emission cost savings
- Congestion cost savings

A rail passenger realizes *affordable mobility benefits* by taking trips that s/he would otherwise forego in the absence of rail. These trips include:

- Family, friends, and leisure
- Business
- Educational
- Commercial and tourism

<sup>1</sup> "Measuring the Economic Impact of the North Carolina Railroad in North Carolina," *RTI International*, September 2014. [http://www.ncrr.com/wp/wp-content/uploads/2011/11/NCRR-Forum-handout-v6\\_09242014.pdf](http://www.ncrr.com/wp/wp-content/uploads/2011/11/NCRR-Forum-handout-v6_09242014.pdf)

<sup>2</sup> "Comprehensive State Rail Plan," *NCDOT Rail Division*, August 2015. <http://www.ncbytrain.org/projects/rail-plan.html>

<sup>3</sup> Values derived using: "Asset Scan Task Order Report," *KPMG*, October 2014.

Expenditure-related economic impacts affect North Carolina’s entire economy. These expenditures support economic activity throughout the state in the form of jobs, wages, and gross state product.

A summary of benefits is provided below, whereas a more detailed accounting of rail customer and expenditure-related economic contribution are provided in the body of this report. In addition to passenger rail services, North Carolina offers rail-based tourism, and Thruway bus services, which are discussed in this report as well.

In North Carolina, students comprise approximately 28 percent of Piedmont and Carolinian ridership. Students, as well as other millennials, have shown to make somewhat fewer automobile trips (-4%) and have traveled considerably fewer miles in an automobile (-18%) than was the case for previous generations at the same stage in their lives, all else equal.<sup>4</sup> As car ownership continues to decline in this age group rail services become all the more essential for passenger transport. Furthermore, as individuals use the Piedmont and Carolinian services, they have a greater proclivity to become repeat users, and thus function to maintain ridership or become catalysts for attracting new passengers.

**BENEFITS FOR PASSENGER RAIL CUSTOMERS**

Benefits from passenger rail use include transportation cost savings and affordable mobility benefits. In North Carolina, rail operations support the following annual benefits to customers:

**Benefits for Passenger Rail Customers**

	<b>Piedmont</b>	<b>Carolinian</b>	<b>Total Benefit</b>
<b>Transportation Cost Savings</b>	\$7.8 million	\$36.9 million	\$44.7 million
<b>Affordable Mobility Benefits</b>	\$0.5 million	\$2.2 million	\$2.7 million
<b>Total Passenger Benefits</b>	\$8.3 million	\$39.1 million	\$47.4 million

Source: ITRE, NCDOT

Transportation cost savings are derived by comparing transportation costs (i.e. operating, travel time, collision, emissions, and congestion) rail passengers experience versus the costs they would face traveling with another mode, if rail were unavailable. Affordable mobility benefits are derived by estimating the value rail passengers place on the trips they make, but would otherwise forego in the absence of rail. Piedmont and Carolinian passenger surveys were used to evaluate passenger travel behavior.

**EXPENDITURE-RELATED ECONOMIC CONTRIBUTION**

Expenditure-related economic contributions include passenger rail operations, maintenance, and capital expenditures. These expenditures generate the following economic contributions in North Carolina:

**Expenditure-Related Economic Contribution**

<b>Systems</b>	<b>Piedmont</b>	<b>Carolinian</b>	<b>Total Impact</b>
<b>Business Output</b>	\$25.9 million	\$35.0 million	\$60.9 million
<b>Gross State Product</b>	\$12.6 million	\$18.0 million	\$30.6 million
<b>Wage Income</b>	\$8.1 million	\$12.0 million	\$20.1 million
<b>Jobs</b>	170	260	430

Source: ITRE, NCDOT, TREDIS

<sup>4</sup> “What’s Youth Got to Do With It? Exploring the Travel Behavior of Teens and Young Adults,” *University of California Transportation Center*, September 2012. <http://www.uctc.net/research/papers/UCTC-FR-2012-14.pdf>

# 1 INTRODUCTION

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## 1.1 REVIEW OF NATIONAL PASSENGER RAIL BENEFITS

In the United States, the National Railroad Passenger Corporation, better known as Amtrak, operates intercity passenger rail service.<sup>5</sup> Amtrak's nationwide passenger rail system includes more than 21,000 miles of routes with 500 destinations in 46 states.<sup>6</sup> Across the U.S., passenger rail services provide a host of economic benefits including approximately \$19.4 billion in annual congestion cost savings, \$12.1 billion in parking cost savings, \$22.6 billion in consumer cost savings and \$50 billion in traffic collision cost savings.<sup>7</sup> A recent study looked at benefits Amtrak provides in all states, and in North Carolina, Amtrak's six train routes, bus services, 22 stations, IT services in Mooresville, and brake shoes expenditures in Laurinburg support approximately 1,510 jobs, \$65 million in wage earnings, and \$72.3 million in value added in North Carolina. Additionally, approximately 160 North Carolina residents are employed with Amtrak.<sup>8</sup>

Passenger rail also supports commercial activity by bringing visitors into proximity of shopping, retail, tourism, and other destinations,<sup>9</sup> thereby increasing business activity and tax revenues. Furthermore, rail services provide improved mobility for non-drivers, increase community livability, and improve public health.<sup>10</sup> A body of economic literature exists, depicting the value of passenger rail services to the regions and states they serve through their operations. Below are findings, which highlight the importance of passenger rail services in economic terms:

- **Maine and New Hampshire:** In 2005, the benefits experienced by Maine and New Hampshire from Amtrak/Downeaster workers spending their wages ranged from: 15-44 jobs, \$434,000 to \$1.3 million in wages, and \$1.5 million to \$4.3 million in total business sales.<sup>11</sup> The Downeaster serves ten passenger stations along a 114-mile route with a ridership of 139,000 in 2005.<sup>12</sup>
- **Massachusetts:** The South Coast Rail Corridor was projected to generate 7,000 to 8,000 jobs and \$315 to \$360 million in household income, during the construction period of the rail project. Additionally, the rail corridor is expected to result in substantial growth in land development in the corridor's surrounding region.<sup>13</sup>

<sup>5</sup> "Measuring the Benefits of Intercity Passenger Rail: A Study of the Heartland Flyer Corridor," *Texas Transportation Institute*, April 2010.

<http://d2dtl5nnlpfr0r.cloudfront.net/swutc.tamu.edu/publications/technicalreports/169116-1.pdf>

<sup>6</sup> Ibid

<sup>7</sup> "Rail Transit in America: A comprehensive Evaluation of Benefits," *Victoria Transport Policy Institute*, January 2012. <http://www.vtpi.org/railben.pdf>

<sup>8</sup> "Amtrak Fact Sheet, Fiscal Year 2012: State of North Carolina," *Amtrak Government Affairs*, Summer 2011.

<sup>9</sup> "Economic Benefits of Amtrak Downeaster Service," *Economic Development Research Group*, February 2005.

<http://www.edrgroup.com/pdf/report-downeaster-final.pdf>

<sup>10</sup> "Rail Transit in America: A comprehensive Evaluation of Benefits," *Victoria Transport Policy Institute*, January 2012. <http://www.vtpi.org/railben.pdf>

<sup>11</sup> "Economic Benefits of Amtrak Downeaster Service," *EDRG and KKO and Associates*, February 2005.

<http://www.edrgroup.com/pdf/report-downeaster-final.pdf>

<sup>12</sup> Ibid

<sup>13</sup> "South Coast Rail Economic Development and Land Use Corridor Plan," *Economic Development Research Group*, June 2009. <http://www.massdot.state.ma.us/Portals/41/Docs/programs/CorridorExecSummary.pdf>

- Montana: The benefits associated with using Amtrak intercity transportation (money saved, automobile costs avoided, lower accident probability, etc.) total over \$7.6 million annually.<sup>14</sup>
- New Hampshire: The Haverhill-Plaistow Commuter Rail extension was estimated to increase daily ridership by 833 passengers per day, where each passenger was estimated to experience vehicle operating cost savings of \$7 per trip.<sup>15</sup>
- New York: Across the state, the 2005-2009 MTA capital program generated almost \$14 billion in business output, during that time period.<sup>16</sup>
- Pennsylvania: Over a five-year period, Southeastern Pennsylvania's Transportation Authority's capital expenditures (passenger rail and transit) supported 5,065 jobs and \$214 million in earnings.<sup>17</sup>
- Vermont: The realignment of commuter service (providing a more direct route that reduces trip length by 11 miles) was estimated to provide \$121.2 million in total benefits with a total cost of \$44.4 million. This provided a net-present value of \$76.8 million and a benefit-cost ratio of 2.7.<sup>18</sup>
- Nationwide: Across the U.S., Amtrak and its passengers generate economic impacts of: \$7.9 billion annually and support over 90,000 jobs.<sup>19</sup>

In alignment with other states, passenger rail service benefits North Carolinians as well. Annually, North Carolina's passenger rail services contribute to 430 jobs, \$20.1 million in earned wages, \$30.6 million in gross state product, and \$47.4 million in benefits rail passengers receive from taking the train instead of other modes of travel. These values are discussed more in depth in the Findings Section of this report.

## 1.2 SCOPE

The economic impacts derived in this report are based on the capital and operational expenditures of the state-supported Piedmont and Carolinian passenger rail services, which were cited in the 2014 KPMG report<sup>20</sup> to the Rail Division of the North Carolina Department of Transportation. Similarly, the wider economic benefits estimated in this report were also based on Carolinian and Piedmont service provision. Thus, the economic contribution values presented in this report do not take into account all passenger rail services in North Carolina. This report does not account for the \$61.8 million in IT expenditures in Research Triangle Park, the \$1.6 million in brake shoes expenditures in Laurinburg,<sup>21</sup> nor expenditures for the long-distance Amtrak routes or their train crews.

<sup>14</sup> "Analysis of the Economic Benefits of the Amtrak Empire Builder to Montana," *R.L. Banks and Associates, Inc.*, July 2003. [https://www.mdt.mt.gov/publications/docs/brochures/railways/empire\\_builder.pdf](https://www.mdt.mt.gov/publications/docs/brochures/railways/empire_builder.pdf)

<sup>15</sup> "Haverhill-Plaistow MBTA Commuter Rail Extension: Benefit Cost Analysis, *HDR*, August 2010. [http://www.plaistow.com/Pages/PlaistowNH\\_BOS/BenefitCostAnalysisMemo.pdf](http://www.plaistow.com/Pages/PlaistowNH_BOS/BenefitCostAnalysisMemo.pdf)

<sup>16</sup> "Built in New York: The Economic Impact of MTA Capital Program Investment on New York State," *Metropolitan Transportation Authority*, October 2011. [http://web.mta.info/capital/pdf/Built\\_in\\_NY-economic\\_impact.pdf](http://web.mta.info/capital/pdf/Built_in_NY-economic_impact.pdf)

<sup>17</sup> "Understanding SEPTA's Statewide Economic Value," *Economy League of Greater Philadelphia*, April 2013. [http://www.septa.org/sustain/pdf/Understanding\\_SEPTAs\\_Statewide\\_Economic\\_Value\\_0.pdf](http://www.septa.org/sustain/pdf/Understanding_SEPTAs_Statewide_Economic_Value_0.pdf)

<sup>18</sup> "Measuring Economic Benefits of Commuter Rail," *HDR*, <https://www.dot.state.oh.us/engineering/OTEC/2010%20Presentations/18E-Bekka.pdf>

<sup>19</sup> "Amtrak's Economic Contribution," *AECOM*, December, 2014. <http://www.amtrak.com/ccurl/256/745/Amtrak-Economic-Contribution-Brochure-051915.pdf>

<sup>20</sup> "Rail Operations and Maintenance: Cost Savings/Revenue Generating Opportunities," *KPMG*, October 2014

<sup>21</sup> "Amtrak Fact Sheet, Fiscal Year 2012: State of North Carolina," *Amtrak*.



## 2 BACKGROUND

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### 2.1 NORTH CAROLINA'S PASSENGER RAIL SERVICE AND BENEFITS

Passenger rail is an important part of the daily lives of many North Carolinians. The state's Carolinian and Piedmont services provide 2,190 trips each year transporting approximately 487,000 passengers over 113 million miles. The Carolinian service transports over 317,000 passengers annually, serving 19 train stations (12 in North Carolina) from Charlotte to New York.<sup>22</sup> On a daily basis, the Carolinian offers one frequency or two train trips – one departure from Charlotte to New York and one departure from New York to Charlotte – with an average of 435 passengers per train.<sup>23</sup> North Carolina's Piedmont rail service transports over 170,000 passengers annually, serving nine train stations from Raleigh to Charlotte.<sup>24</sup> On a daily basis, the Piedmont offers two frequencies or four train trips – two departures from Raleigh to Charlotte and two departures from Charlotte to Raleigh – with an average of 117 passengers per train.<sup>25</sup> See Exhibit 1 (on the following page) for the extent of North Carolina's passenger rail services.

These trips made to work, school, training opportunities, shopping locations, tourist areas, and other destinations provide a substantial benefit to North Carolina passenger rail customers. In addition, passenger rail operations benefit the state's economy as they provide a source of employment and income. Fully understanding the costs and benefits passenger rail provides to its customers and to the state's economy can be helpful when making decisions regarding passenger rail investment.

The purpose of this study is to evaluate the benefits of North Carolina's passenger rail systems. There are three primary areas in which passenger rail service offers economic benefits to its passengers or enhances economic activity throughout the state:

- Transportation cost savings – benefits realized by traveling via passenger rail instead of by alternative modes
- Affordable mobility benefits – benefits derived from trips that would be foregone in the absence of rail service
- Expenditure-related economic contribution – impacts to the state's economy resulting from expenditures related to rail operations

The estimated values of transportation cost savings, affordable mobility benefits, and expenditure-related contributions associated with the Piedmont and Carolinian passenger rail services are presented in the findings section. The methods and sources used to derive these values are discussed in the methodology section.

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<sup>22</sup> "Rail Operations and Maintenance: Cost Savings/Revenue Generating Opportunities," KPMG, October 2014

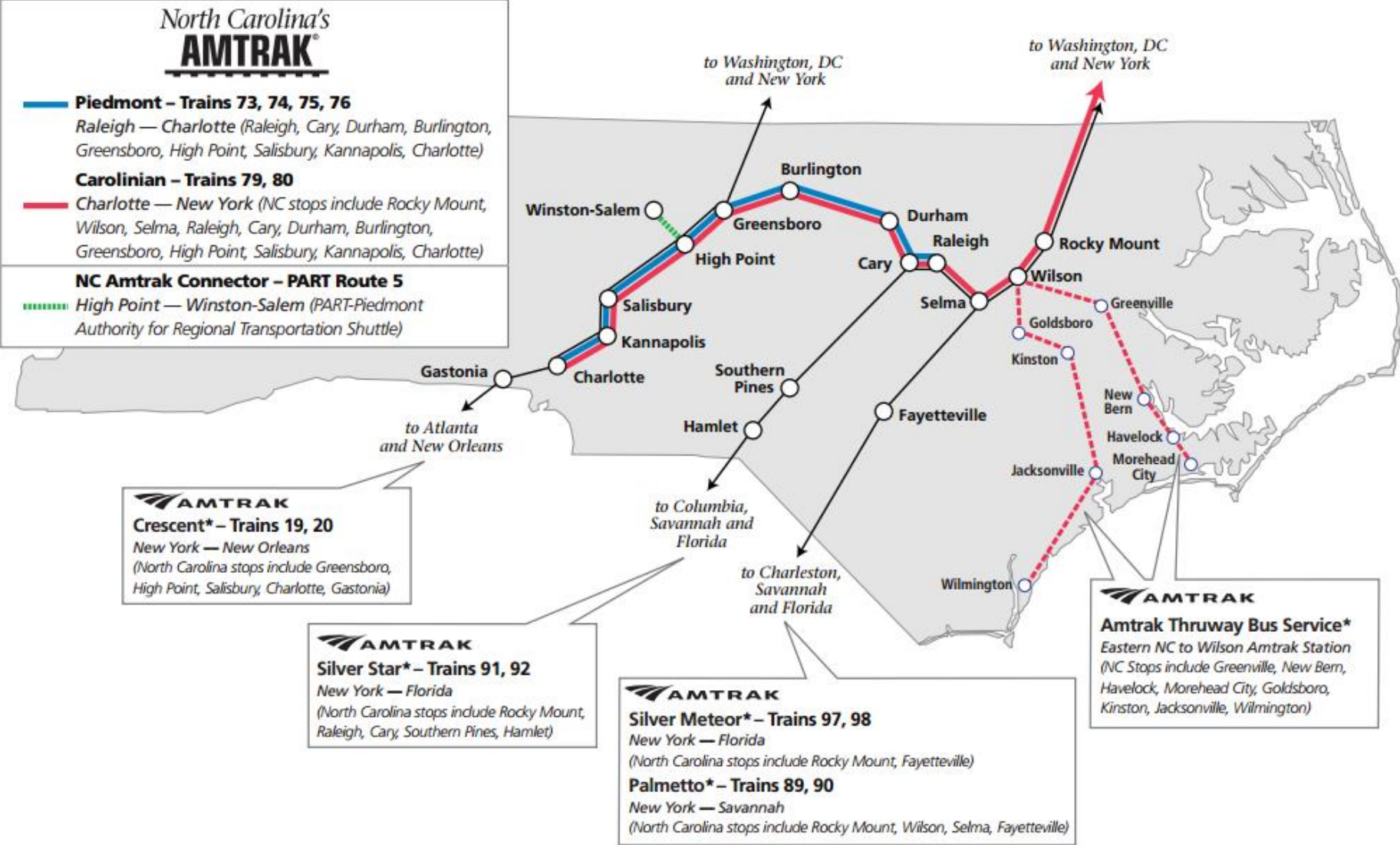
<sup>23</sup> "Amtrak Fact Sheet: Carolinian Service." *National Association of Railroad Passengers*. 2013.

<sup>24</sup> "Rail Operations and Maintenance: Cost Savings/Revenue Generating Opportunities," KPMG, October 2014

<sup>25</sup> "Amtrak Fact Sheet: Piedmont Service." *National Association of Railroad Passengers*. 2013.

Exhibit 1: North Carolina's Passenger Rail Services

Source: NCDOT



## 2.2 NORTH CAROLINA RAIL-BASED TOURISM

The Great Smoky Mountains Railroad is a tourist rail service in western North Carolina, operating from Dillsboro to Nantahala and serving over 200,000 visitors annually.<sup>26</sup> In 2007, the Great Smoky Mountains Railroad contributed a total of \$61.8 million and supported 814 additional jobs to the Carolina Smokies, which includes Buncombe, Cherokee, Clay, Graham, Haywood, Jackson, Macon, and Swain counties.<sup>27</sup> More specifically, the Great Smoky Mountains Railroad had a direct impact of \$46.3 million, an indirect impact of \$7.4 and an induced impact of \$8.1 million on the local economy.<sup>28</sup> Of the visitors, nearly 70 percent hold a 2-year degree or higher; nearly 20 percent have an annual household income of more than \$100,000; more than 40 percent have an annual household income between \$60,000 and \$99,999; and slightly over 60 percent are women.<sup>29</sup> North Carolina also offers smaller tourist rail attractions such as the New Hope Valley Railway in Bonsal,<sup>30</sup> the North Carolina Transportation Museum's train rides in Spencer,<sup>31</sup> and the Tweetsie Railroad in Blowing Rock.<sup>32</sup>

## 2.3 NORTH CAROLINA THRUWAY BUS SERVICE AND AMTRAK CONNECTOR

Amtrak provides a Thruway Bus service to connect individuals living in the southeastern part of North Carolina to passenger rail services. Over 11 percent of North Carolina's population is within a 30-mile radius of stops served by Amtrak's Thruway bus service.<sup>33</sup> Service includes two routes that operate twice daily. The first route serves Greenville, New Bern, Havelock, and Morehead City, and the second route serves Goldsboro, Kinston, Jacksonville, and Wilmington. Both bus routes average approximately 430 monthly riders, with stops in Greenville and Jacksonville having the largest share.<sup>34</sup> Additionally, NCDOT and the Piedmont Authority for Regional Transportation provide the NC Amtrak connector bus, which connects Winston-Salem to and from the Carolinian and Piedmont trains at High Point station. The connector buses operate six times daily.

NCDOT is evaluating extending Thruway Bus services on the following routes that would connect to the Piedmont and Carolinian passenger rail services:<sup>35</sup>

<sup>26</sup> "History," *Great Smoky Mountains Railroad*, accessed July 23, 2015, <http://www.gsmr.com/train-history#.VbJXJ7NVhBc>.

<sup>27</sup> Inhyuck Ha, Hillary M. Sherman, and Jessica Hollars. "Smoky Mountain Host Highway 19 Corridor Study Phase I," *Western Carolina University*, March 2009. [http://www.americaoutdoors.org/america\\_outdoors/files/pdf/Western%20NC%20study%202009.pdf](http://www.americaoutdoors.org/america_outdoors/files/pdf/Western%20NC%20study%202009.pdf).

<sup>28</sup> Inhyuck Ha, Hillary M. Sherman, and Jessica Hollars. "Smoky Mountain Host Highway 19 Corridor Study Phase I," *Western Carolina University*, March 2009. [http://www.americaoutdoors.org/america\\_outdoors/files/pdf/Western%20NC%20study%202009.pdf](http://www.americaoutdoors.org/america_outdoors/files/pdf/Western%20NC%20study%202009.pdf).

<sup>29</sup> Inhyuck Ha, Hillary M. Sherman, and Jessica Hollars. "Smoky Mountain Host Highway 19 Corridor Study Phase I," *Western Carolina University*, March 2009. [http://www.americaoutdoors.org/america\\_outdoors/files/pdf/Western%20NC%20study%202009.pdf](http://www.americaoutdoors.org/america_outdoors/files/pdf/Western%20NC%20study%202009.pdf).

<sup>30</sup> "About," *New Hope Valley: The Triangle's Train*, accessed July 23, 2015, <http://www.triangletrain.com/about/>.

<sup>31</sup> *North Carolina Transportation Museum*, accessed July 23, 2015, <http://www.nctrans.org/>.

<sup>32</sup> Tweetsie Railroad: Wild West Theme Park, *Tweetsie Railroad* <http://tweetsie.com/>.

<sup>33</sup> "Implementing the 25-year vision," *NCDOT Rail Division*, February 2015. [http://www.ncbytrain.org/\\_resources/download/DraftStateRailPlanFullReport.pdf](http://www.ncbytrain.org/_resources/download/DraftStateRailPlanFullReport.pdf)

<sup>34</sup> "Implementing the 25-year vision," *NCDOT Rail Division*, February 2015. [http://www.ncbytrain.org/\\_resources/download/DraftStateRailPlanFullReport.pdf](http://www.ncbytrain.org/_resources/download/DraftStateRailPlanFullReport.pdf)

<sup>35</sup> Ibid

- Greensboro-Winston-Salem-Asheville (or Salisbury-Asheville)
- Raleigh-Henderson-Richmond
- Charlotte-Greenville/Spartanburg
- Raleigh-Goldsboro
- Raleigh-Wilmington
- Charlotte-Rock Hill-Columbia
- Raleigh-Fayetteville

These services are expected to both increase ridership on the existing state-sponsored Piedmont and Carolinian trains, and build ridership for future expansion of passenger rail service along new corridors.<sup>36</sup>

## 2.4 FUTURE OUTLOOK

### 2.4.1 Potential of Fourth and Fifth Frequencies

North Carolina passenger rail service has experienced substantial growth over the last decade. Since 2004, Carolinian ridership has increased 38 percent and Piedmont ridership has increased by 280 percent.<sup>37</sup> Based on favorable ridership conditions and projected population growth in North Carolina, plans are underway to add stations at points including Hillsborough, Lexington, and Harrisburg, and add another two frequencies (the 4<sup>th</sup> and 5<sup>th</sup> frequencies) to the Piedmont service.<sup>38</sup> Piedmont service operations, maintenance, and capital expenditures currently support over 160 jobs, \$8.1 million in earned income, and over \$12.5 million in gross state product;<sup>39</sup> additional service would further enhance the state’s economic output and likely add to passenger rail ridership with more travel options due to the increased frequency and station options.

### 2.4.2 Other Proposed Passenger Rail Projects

In addition to offering fourth and fifth frequencies for the Piedmont service, NCDOT’s Rail Division is looking into other passenger rail service improvements that will further benefit train passengers and improve the state’s economy. These improvements and their timeframes are included in the exhibit below.

**Exhibit 2: Proposed Passenger Rail Projects and Time Frame**

Proposed Project	Time Frame
Western Thruway Bus Service between Piedmont area of NC and Asheville	2016
Positive Train Control for enhanced safety	2016
Construct Hillsborough station and platform	2018
Expand Thruway Bus Service to Wilmington and other markets	2018
Fourth and fifth frequencies on Piedmont	2017-2018 (4 <sup>th</sup> ); 2019 (5 <sup>th</sup> )
Replace Carolinian trainsets at the end of their service lives	2020-2035
New stations at Lexington and Harrisburg	2020-2035
New and relocated Charlotte Gateway Station	2020-2035
Raleigh to Richmond full Southeast Corridor Implementation	2020-2035
Western passenger service between Salisbury and Asheville	2020-2035
Fayetteville, Wilson, and Selma station improvements for ridership ↑	2020-2035
Southeastern NC Passenger Service (Raleigh to Wilmington)	2020-2035

Source: NCDOT

<sup>36</sup> “Implementing the 25-year vision,” *NCDOT Rail Division*, February 2015. <http://www.ncbytrain.org/resources/download/DraftStateRailPlanFullReport.pdf>

<sup>37</sup> Ibid

<sup>38</sup> Ibid

<sup>39</sup> Economic contribution derived using expenditure data from NCDOT as inputs into TREDIS software.

Passenger rail improvements will help increase ridership and enhance the overall experience for existing ridership. Currently, North Carolina is served by six intercity passenger routes (14 daily passenger trains with stops in 16 communities).<sup>40</sup> In addition, bus services partnering with North Carolina passenger rail enable other communities to access train routes or reach destinations not yet serviced by rail. Over 55 percent of North Carolina’s population lives within a 30-minute drive of the Carolinian or Piedmont rail lines,<sup>41</sup> and an additional 11 percent of the state’s residents are within a 30-minute drive of stops served by the state’s Thruway Bus Service (see Exhibit 12).<sup>42</sup>

### 2.4.3 Habitual Mode Selection and the Propensity of Repeat Customers

Research on the process of making travel mode choices indicates that passenger rail ridership can be expected to maintain or increase if individuals get into the habit of using passenger rail services<sup>43</sup> or if situations in individuals’ lives, such as commuting, lead to high levels of frustration.<sup>44</sup> Thus, if North Carolina residents develop a pattern of using Piedmont and Carolinian passenger rail services, and/or frustration associated with traffic congestion continues to grow in North Carolina’s urban areas, then the state’s passenger rail ridership can be expected to maintain or increase. Currently, 47 universities and colleges are within a 20-mile range of the Piedmont line<sup>45</sup> and 28 percent of Piedmont ridership is students (see Exhibit 3 for student population in proximity to passenger rail services).<sup>46</sup> As this demographic forms habits of using the train to reach destinations of interest, it increases the propensity for students to continue using the train after they graduate.

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<sup>40</sup> “Implementing the 25-year vision,” *NCDOT Rail Division*, February 2015.

[http://www.ncbytrain.org/\\_resources/download/DraftStateRailPlanFullReport.pdf](http://www.ncbytrain.org/_resources/download/DraftStateRailPlanFullReport.pdf)

<sup>41</sup> U.S. Census Bureau, 2010.

[http://www.osbm.state.nc.us/ncosbm/facts\\_and\\_figures/socioeconomic\\_data/census\\_home.shtm](http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/census_home.shtm)

<sup>42</sup> “Implementing the 25-year vision,” *NCDOT Rail Division*, February 2015.

[http://www.ncbytrain.org/\\_resources/download/DraftStateRailPlanFullReport.pdf](http://www.ncbytrain.org/_resources/download/DraftStateRailPlanFullReport.pdf)

<sup>43</sup> “Habit, information acquisition, and the process of making travel mode choices,” *European Journal of Social Psychology*, 1997.

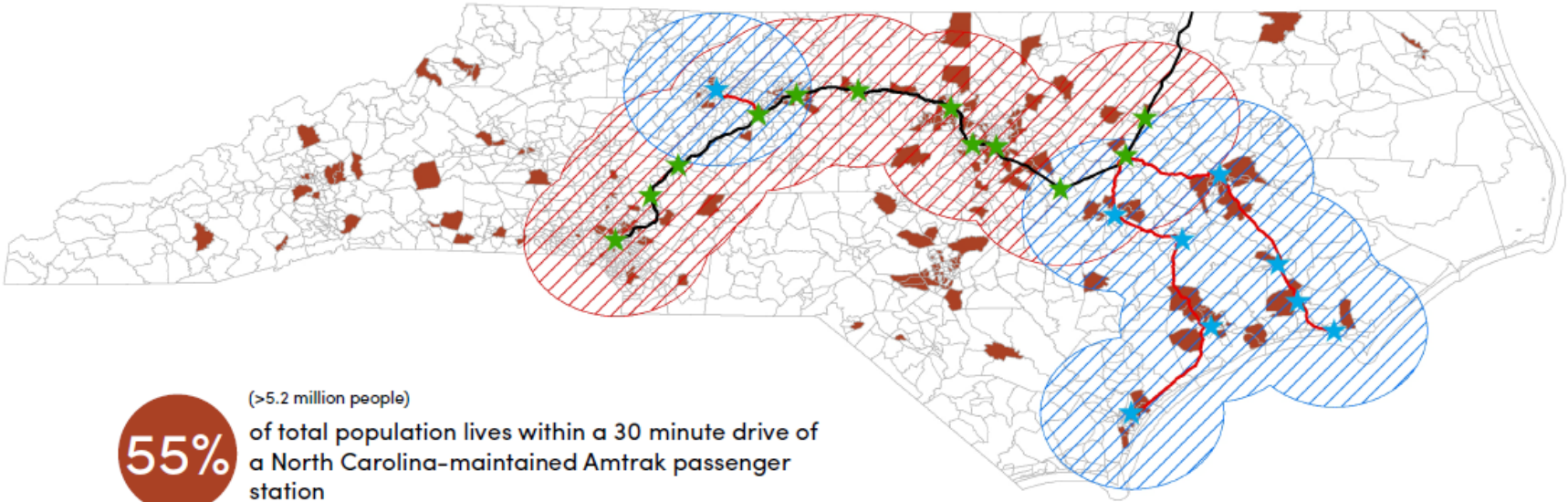
[http://goallab.nl/publications/documents/Verplanken,%20Aarts,%20van%20Knippenberg%20\(1997\)%20-%20habit,%20information%20aquisition,%20and%20travel%20mode%20choices.pdf](http://goallab.nl/publications/documents/Verplanken,%20Aarts,%20van%20Knippenberg%20(1997)%20-%20habit,%20information%20aquisition,%20and%20travel%20mode%20choices.pdf)

<sup>44</sup> “What affects mode choice,” *Journal of Transport Geography*, 2005. <http://www.uctc.net/papers/732.pdf>

<sup>45</sup> Correspondence with NCDOT.

<sup>46</sup> “Piedmont and Carolinian Fall and Spring 2014 On-board Survey Results,” *Parsons Brinckerhoff*, 2015.

**Exhibit 3: General and Student Population within 30-miles of Piedmont, Carolinian, and Thruway Bus Stations**

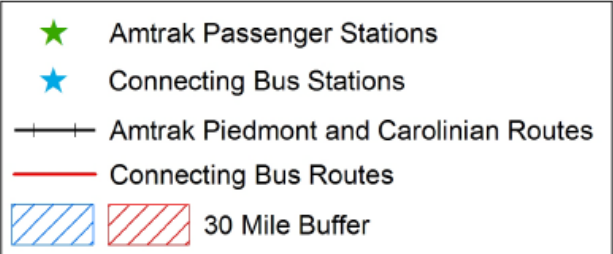


(>5.2 million people)  
**55%** of total population lives within a 30 minute drive of a North Carolina-maintained Amtrak passenger station

(>418,000 students)  
**58%** of students enrolled in a college or university live within a 30 minute drive of an North Carolina-maintained Amtrak passenger station

(>6.3 million people)  
**66%** of total population lives within a 30 minute drive of an North Carolina-maintained Amtrak passenger station or connection bus station

(>515,000 students)  
**71%** of students enrolled in a college or university live within a 30 minute drive of an North Carolina-maintained Amtrak passenger station or connecting bus station



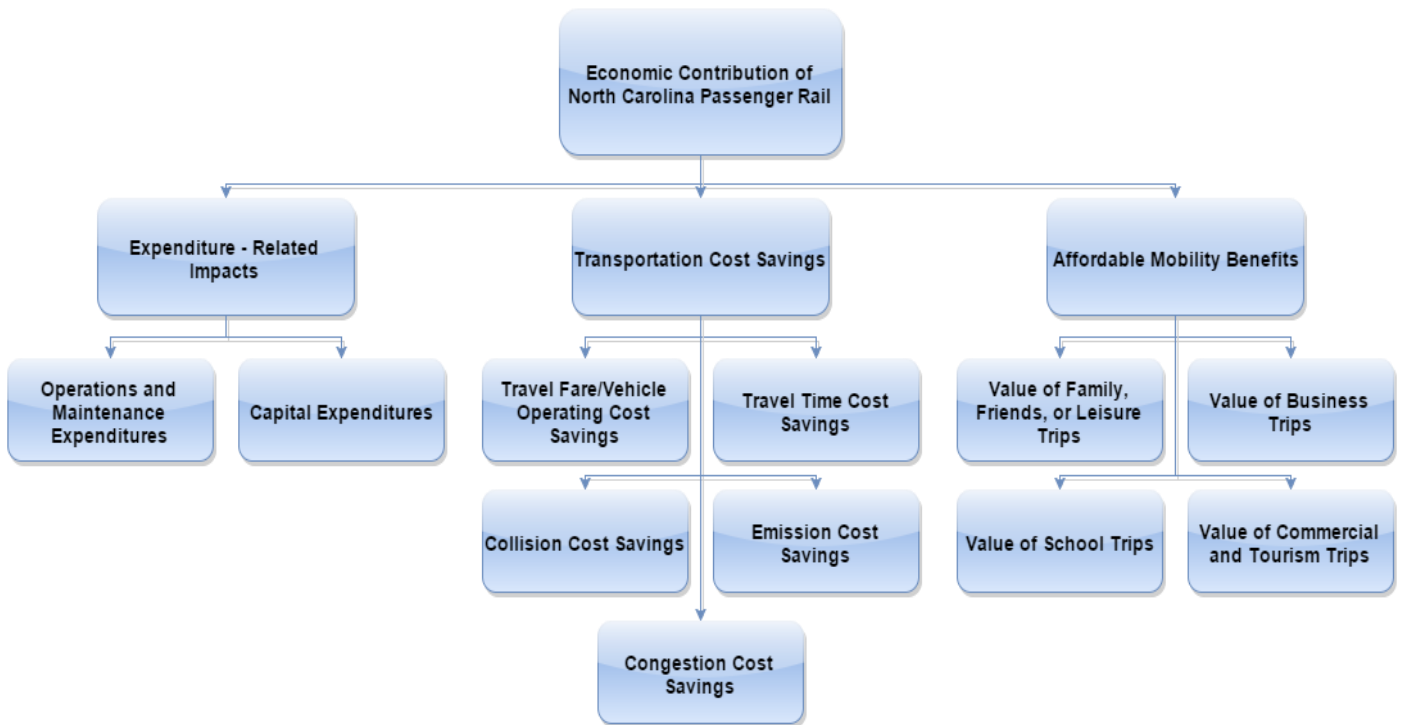
\*Filled census tract areas indicate 500 or more persons enrolled in a university or college in 2013

Sources: NCDOT, ACS Survey 2013, US Census 2010

### 3 METHODOLOGY

The potential benefits of North Carolina passenger rail operations are two-fold: they offer individual benefits to train passengers and overall benefits to North Carolina’s economy. The methodology used to determine these benefits can be conceptualized through the use of a passenger rail benefits assessment tree as shown in Exhibit 4.

**Exhibit 4: Assessment Tree of Passenger Rail Benefits and Expenditure-Related Economic Contribution**



Source: ITRE

#### 3.1 BENEFITS FOR PASSENGER RAIL CUSTOMERS

If passenger rail services were not provided, then train passengers would have to find another method to travel or forego their trips altogether. Thus, benefits of using passenger rail are determined by deriving the savings that result when individuals are able to use rail service in place of another mode (transportation cost savings), and when trips are made that would otherwise be foregone (affordable mobility benefits). This approach, when paired with North Carolina passenger rail data, enables the economic and societal benefits of rail service to be evaluated.

##### 3.1.1 Transportation Cost Savings

A potential outcome of rail service is a reduction in transportation costs for those who use passenger rail in place of another mode of travel. To evaluate this outcome, the following transportation cost components were evaluated:

- ❖ Travel fare and operating costs
- ❖ Travel time and productivity costs
- ❖ Collision costs
- ❖ Emission costs
- ❖ Congestion costs

Each of these transportation cost components are evaluated for passenger rail and then compared to those of other modes. It is important to note that some of the components may have negative values if customers experience greater costs, instead of savings, by taking passenger rail in lieu of other modes. However, if passenger rail operations offer a net benefit, or an overall lower cost when summing all of these transportation cost components, then passenger rail operations would provide individuals with transportation cost savings. For this study, a number of different data sources and methodologies were used to derive these benefits. These methods and sources are detailed in the following subsections.

#### 3.1.1.1 Travel Fare and Operating Cost Savings

If passenger rail were not available, some passengers would make the trip in automobiles, buses, or take a flight. Therefore, train passengers using other modes of travel for their trips would incur vehicle ownership and operating expenses, bus ticket fares, or airline ticket fares, which may be more costly to the individual than using the train to make the trip. The savings can be estimated based on the difference of the per-mile cost an individual incurs for using another mode versus taking the train. This per-mile differential is then multiplied by the length of that individual's trip to determine the full cost or benefit felt by that individual. When taken in aggregate (by all passenger rail users across the state), these costs can show the total direct cost savings North Carolina's passenger rail operations provide.

Train<sup>i</sup>, aircraft<sup>ii</sup>, car<sup>iii</sup>, and bus<sup>iv</sup> travel fare and operating costs were derived based on average ticket fares or operating expenses per passenger mile, the percentage of trips made by each mode in the absence of passenger rail, and trip length.

#### 3.1.1.2 Travel Time and Productivity Cost Savings

Train service may provide passengers with shorter commute times than if they were to travel by personal vehicle or bus, especially when traveling through congested corridors. Furthermore, train service enables passengers to be productive during their travel times.<sup>47</sup> If passenger rail were not available, some passengers would make the trip in their personal automobiles, buses, or take a flight. Time costs and utility benefits of train travel are compared to those that individuals experience in cars, buses, and flights to determine the *Travel Time and Productivity Cost Savings* that passenger rail service provides.

Train<sup>v</sup>, aircraft<sup>vi</sup>, car<sup>vii</sup>, and bus<sup>viii</sup> travel time and productivity costs were derived based on North Carolina's median wage rate, the proportion of productive time during a trip, travel times, trip lengths, and the percentage of trips made by each mode in the absence of passenger rail.

#### 3.1.1.3 Collision Cost Savings

Passenger rail is a relatively safe mode of travel which often provides collision cost savings for its customers. Collision cost savings are derived by comparing the collision costs of passenger rail to the collision costs of other modes that would be utilized in the absence of rail.

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<sup>47</sup> "The Use of Travel Time by Rail Passengers in Great Britain," *Center for Transport and Society*, May 2006.  
<http://www.sciencedirect.com/science/article/pii/S0965856406000644>



Train<sup>ix</sup>, aircraft<sup>x</sup>, car<sup>xi</sup>, and bus<sup>xii</sup> collision costs were derived based on fatalities per passenger mile, value of statistical life, trip lengths, and the percentage of trips made by each mode in the absence of passenger rail.

#### 3.1.1.4 Emission Cost Savings

As buses, trains, flights, and automobiles transport individuals to their destinations they emit air pollutants. When evaluating emissions on a per-user basis, trains are often a low emitter of air pollution relative to other modes. Emission cost savings are derived by comparing the emission costs of passenger rail to the emission costs of other modes that would be utilized in the absence of rail. Piedmont and Carolinian passengers were surveyed<sup>xiii</sup> to determine which modes of transportation they would use in the absence of passenger rail, and survey results were used to estimate emission cost savings.

Train<sup>xiv</sup>, aircraft<sup>xv</sup>, car<sup>xvi</sup>, and bus<sup>xvii</sup> emission costs were derived based on emissions per mile, emission costs, trip lengths, and percentage of trips made by each mode in the absence of passenger rail.

#### 3.1.1.5 Congestion Cost Savings

Passenger rail may alleviate congestion if individuals choose to take the train instead of choosing to drive – thereby diverting vehicles from the roadway. However, passenger rail may also increase congestion if their movements prevent vehicles from reaching their destinations through closed gates of at-grade highway crossings. Thus, determining a value of congestion for passenger rail requires evaluating the net congestion benefit passenger rail provides (congestion diverted less congestion imposed).

**Congestion Diverted.** Passenger rail facilities enable individuals the option to reach their destinations by taking the train. In doing so, many of these individuals elect to take the train instead of driving their personal vehicles to reach their destinations. In North Carolina, for every 1.2 passenger miles a train route supports, it diverts an estimated one vehicle mile from the roadway.<sup>48</sup> As these vehicles are diverted from the roadway, so are their external congestion costs.

**Congestion Imposed.** Passenger trains may cause traffic congestion if their movements prevent vehicles from reaching their destinations through delay at at-grade crossings. In North Carolina, trains impact approximately 51,000 vehicles daily for average delay of 2.3 minutes.<sup>49</sup> This delay results in their external congestion costs.

**Net Passenger Rail Congestion Value.** For this study, the project team took the difference of the annual congestion and emissions costs diverted and the annual congestion and emissions costs imposed to estimate the net impact North Carolina passenger rail has on congestion.

Train<sup>xviii</sup>, aircraft<sup>xix</sup>, car<sup>xx</sup>, and bus<sup>xxi</sup> congestion costs were derived based on vehicle miles converted to train miles, delay at at-grade crossings, additional fuel costs per passenger mile, and the percentage of trips made by each mode in the absence of passenger rail.

<sup>48</sup> Congestion Mitigation and Air Quality Project Application, “Calculation of Pollutant Reduction Attributable to Proposed Hillsborough Train Station,” NCDOT, July 2011.

<sup>49</sup> Average delay derived from taking the weighted average of delay values cited five CMAQ project applications provided by NCDOT from July 2011. CMAQ applications were for Cabarrus, Durham, Guilford, Rowan, and Wake counties.

### 3.1.1.6 Cost Savings Not Addressed

The cost savings considered in this research are not exhaustive, but represent a comprehensive estimate of the most significant types of savings. Use of passenger rail also may save parking costs, which can be substantial depending on the region. In addition, impacts on land use are not included. Agglomeration economics, quality of life issues, relocation cost savings, groundwater pollution cost savings, land conservation benefits, and the provision of transportation service during emergencies represent additional potential cost savings<sup>50</sup> from use of passenger rail – none of which were included in this study.

## 3.2 AFFORDABLE MOBILITY BENEFITS

Affordable mobility benefits result when rail passengers make trips that would otherwise be foregone in the absence of passenger rail. The costs of those foregone trips can be substantial. Lost educational trips could reduce a person’s future earnings potential; lost shopping or tourism trips mean less money is spent in the community; lost business trips could result in lower economic output; and lost family and leisure trips could reduce an individual’s quality of life. Piedmont and Carolinian passengers were surveyed for trip purpose and a portion reported that they would not make their trip in the absence of passenger rail service (even with another mode).<sup>xxii</sup> Thus, these individuals who would forego making their trips would lose the value they derive from these trips. For this study, affordable mobility benefits are derived from the costs of foregone:

- ❖ Business trips
- ❖ Education trips
- ❖ Commercial and tourism trips
- ❖ Family, friend, or other leisure trips

### 3.2.1 Value of Foregone Trips

Various economic research estimates that individuals value travel at 35-175% of their given wage rate,<sup>51</sup> and this large range suggests that a more consistent method is required to monetize the value of passenger trips made. For this study the project team assumed that each passenger rail customer was a rational individual thus the money passengers spent on ticket fares represented at least the value of making that trip. This is a conservative approach to estimating the value passengers place on a train trip, because an individual may likely derive greater value than the cost of the ticket fare for making a trip. Nevertheless, the project team deemed a conservative approach to be suitable for deriving the benefits of passenger rail service provision (affordable mobility benefits). Business<sup>xxiii</sup>, education<sup>xxiv</sup>, commercial & tourism<sup>xxv</sup>, and family, friends, & other leisure<sup>xxvi</sup> trips were derived based on the average ticket fare and the percentage of each trip type that would be foregone in the absence of passenger rail.

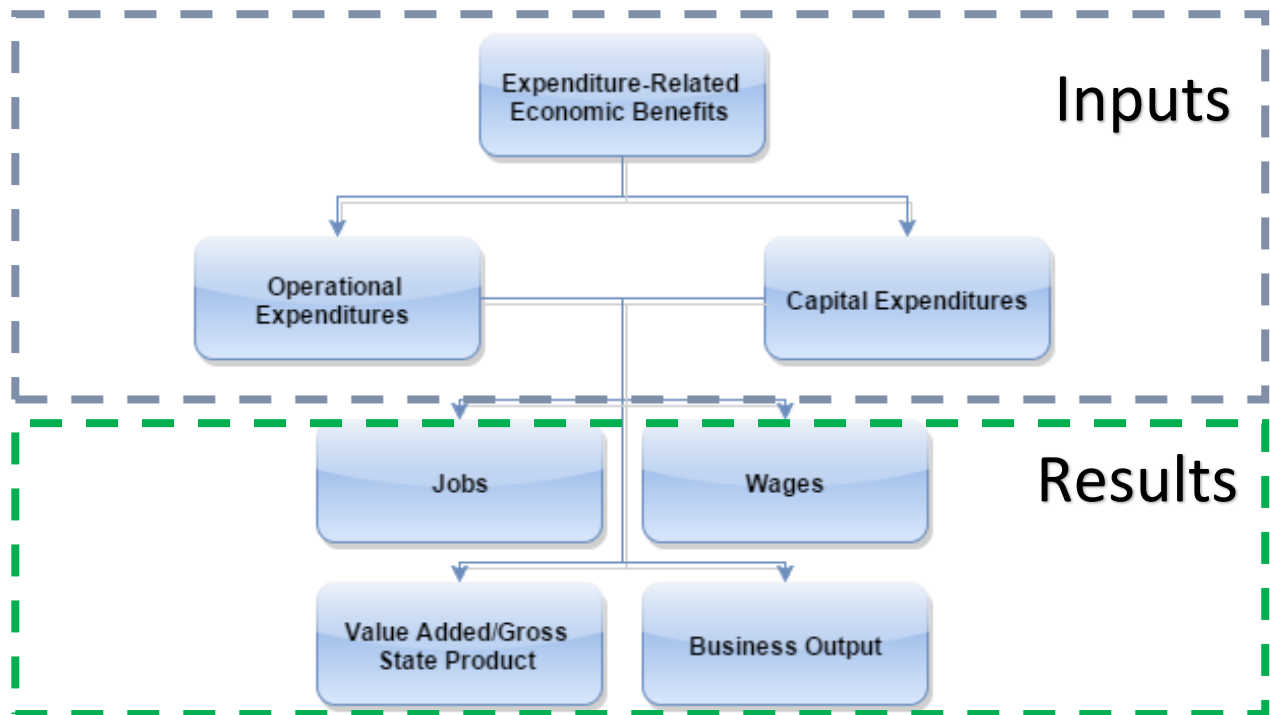
<sup>50</sup> Ranjit Godavarthy, Jeremy Mattson, and Elvis Ndembe, “Cost-Benefit Analysis of Rural and Small Transit,” National Center for Transit Research: North Dakota State University Upper Great Plains Transportation Institute – Small Urban and Rural Transit Center, October 2014. <http://www.nctr.usf.edu/wp-content/uploads/2015/01/77060-NCTR-NDSU03-508.pdf>

<sup>51</sup> “The Value of Travel Time Savings: Departmental Guidance for Conducting Economic Evaluations Revision 2,” USDOT, September 2011. <https://www.transportation.gov/sites/dot.gov/files/docs/Value%20of%20Travel%20Time%20Memorandum.pdf>

### 3.3 EXPENDITURE-RELATED ECONOMIC CONTRIBUTION

For this study, passenger rail expenditure-related economic contribution refers to statewide economic effects generated from the capital and operational expenditures of North Carolina’s passenger rail systems. These impacts include direct and indirect spending and induced economic activity. The direct effects include jobs created by North Carolina passenger rail systems – train and engine crew, general and administrative staff, reservation and call center staff, etc. The indirect effects result from jobs supported and income spent in industries that supply inputs or services to passenger rail, such as fuel, repairs, insurance, marketing, etc. Induced economic activity results from the income generated through both the direct and indirect effects. The induced effects occur when passenger rail employees or the employees of passenger rail suppliers spend their earned income in North Carolina. This spending supports additional jobs in the state.

**Exhibit 5: Passenger Rail Expenditure-Related Economic Benefits**



Source: ITRE

The Transportation Economic Development Impact System (TREDIS) software version 4.0 was used to derive the expenditure-related economic benefits associated with North Carolina passenger rail service operations, maintenance, and capital expenditures. TREDIS is NCDOT’s current economic modeling tool. Operational (operations & maintenance) and capital expenditures were inputs into TREDIS.<sup>52</sup> The TREDIS software then used these inputs to derive the jobs, wages, business output, and gross state product supported by these rail expenditures. Exhibit 5 shows how expenditures are used as inputs in TREDIS to generate expenditure-related economic contribution.

<sup>52</sup> Capital and operational expenses were taken from NCDOT’s Asset Scan Task Order Report - “Rail Operations and Maintenance: Cost Savings/Revenue Generating Opportunities,” KPMG, October 2014 and NCDOT correspondence.

## 4 FINDINGS

North Carolina’s Piedmont and Carolinian passenger rail services provide transportation cost savings, affordable mobility benefits, and expenditure related economic contributions. Transportation cost savings are benefits passengers realize by traveling via train instead of by alternative modes. Affordable mobility benefits are benefits that passengers derive from trips that would be foregone in the absence of rail service. Expenditure-related economic contribution refers to the changes in the state’s economy (i.e. jobs, wages, value added, and business output) that result from the capital and operational expenditures associated with passenger rail service. These user benefits and economic impacts are detailed below.

### 4.1 TRANSPORTATION COST SAVINGS

In North Carolina, passenger rail operations generate the following annual transportation cost savings:

**Exhibit 6: Transportation Cost Savings**

<b>Annual Transportation Cost Savings</b>	<b>Piedmont Benefits</b>	<b>Carolinian Benefits</b>	<b>Total Benefits</b>
Operating Cost/Ticket Fare	\$5.1 million	\$26.1 million	\$31.2 million
Travel Time and Productivity	\$0.4 million	\$1.0 million	\$1.4 million
Collision	\$0.8 million	\$3.3 million	\$4.1 million
Emissions	\$0.4 million	\$1.9 million	\$2.3 million
Congestion	\$1.1 million	\$4.6 million	\$5.6 million
<b><i>Transportation Cost Savings</i></b>	<b>\$7.8 million</b>	<b>\$36.9 million</b>	<b>\$ 44.7 million</b>

Sources: ITRE and NCDOT

### 4.2 AFFORDABLE MOBILITY BENEFITS

In North Carolina, passenger rail operations generate the following annual affordable mobility benefits:

**Exhibit 7: Affordable Mobility Benefits**

<b>Foregone Trip Cost Categories<sup>A</sup></b>	<b>Piedmont Benefits</b>	<b>Carolinian Benefits</b>	<b>Total Benefits</b>
<b>Work</b>	\$80,000	\$310,000	\$390,000
<b>School</b>	\$50,000	\$90,000	\$140,000
<b>Commercial and Tourism</b>	\$30,000	\$160,000	\$190,000
<b>Family, Friend, Leisure</b>	\$360,000	\$1,600,000	\$1,960,000
<b><i>Foregone Trip Cost Savings</i></b>	<b>\$0.5 million</b>	<b>\$2.1 million</b>	<b>\$2.7 million</b>

<sup>A</sup>Trip categories were established based on Piedmont and Carolinian passenger survey responses.

Sources: ITRE and NCDOT

### 4.3 BENEFITS PER PASSENGER MILE

Transportation cost savings and affordable mobility benefits divided by the total number of passenger miles provides the benefit a passenger receives during each mile of travel onboard a Piedmont or Carolinian train. The following exhibit shows the benefit each passenger accrues per mile of travel:

**Exhibit 8: Average Passenger Benefit per Mile Traveled**

Benefit Type	Statewide
Transportation Cost Savings	\$0.43
Affordable Mobility Benefits	\$0.02
<b>Total Benefit per Passenger Mile</b>	<b>\$0.45</b>

Sources: ITRE and NCDOT

### 4.4 BENEFITS PER PASSENGER TRIP

Transportation cost savings and affordable mobility benefits per passenger mile multiplied by the average passenger trip distance provides the benefit a passenger receives during a train trip. The following exhibit shows this benefit:

**Exhibit 9: Average Passenger Benefit per Trip**

Benefit Type	Piedmont	Carolinian	Average Passenger Rail Benefit per Trip
Transportation Cost Savings	\$46.42	\$116.18	\$105.07
Affordable Mobility Benefits*	\$3.11	\$6.80	\$4.34
<b>Total Benefit per Passenger Trip</b>	<b>\$49.53</b>	<b>\$122.99</b>	<b>\$109.41</b>

Sources: ITRE and NCDOT

\* In the absence Carolinian or Piedmont services only a portion of passengers forego making their trips, the other passengers make their trips via another mode. For consistency, this exhibit averages affordable mobility benefits (the value of trips foregone) across all passengers. However, another way to view affordable mobility benefits is by just looking at the benefits to those who forego the trips. Thus, when not averaged across all passengers affordable mobility benefits are equal approximately \$20 for Piedmont passengers who would forego making the trip, \$63 for Carolinian passengers who would forego making the trip, and \$47 for the average passenger would forego making the trip.

### 4.5 EXPENDITURE-RELATED ECONOMIC CONTRIBUTION

Passenger rail operations, maintenance and capital expenditures generate the following economic contribution in North Carolina:

**Exhibit 10: Aggregated Expenditure-Related Economic Contribution**

Economic Impact	Piedmont	Carolinian	Total Impact
Business Output	\$25.9 million	\$35.0 million	\$60.9 million
Gross State Product	\$12.6 million	\$18.0 million	\$30.6 million
Wage Income	\$8.1 million	\$12.0 million	\$20.1 million
Jobs	170	260	430

Sources: ITRE, NCDOT, and TREDIS

## Methodological Sources Used for Deriving Transportation Cost Savings

<sup>i</sup> North Carolina Department of Transportation (NCDOT)

<sup>ii</sup> Ticket fares: “Domestic Airline Consumer Airport Report,” US Department of Transportation, April 2015.

<http://www.transportation.gov/policy/aviation-policy/domestic-airline-consumer-airfare-report>

<sup>iii</sup> Vehicle ownership and operation costs: “Your Driving Costs for 2015,” American Automobile Association, April 2013.

<http://newsroom.aaa.com/2013/04/cost-of-owning-and-operating-vehicle-in-u-s-increases-nearly-two-percent-according-to-aaas-2013-your-driving-costs-study/>

<sup>iv</sup> Ticket fares estimated from an average of the bimonthly “advanced purchase” values. Source: “Tickets,” Greyhound,

<https://www.greyhound.com/farefinder/step1.aspx>

Trip length: Google Maps. <https://www.google.com/maps>

<sup>v</sup> Median wage rate: “State Occupational Employment and Wage Estimates: North Carolina,” Bureau of Labor and Statistics, May 2014. [http://www.bls.gov/oes/current/oes\\_nc.htm#00-0000](http://www.bls.gov/oes/current/oes_nc.htm#00-0000)

<sup>vi</sup> Median wage rate: *ibid*; speed of travel

<sup>vii</sup> Median wage rate: *ibid*; speed of travel

<sup>viii</sup> Median wage rate: *ibid*; speed of travel

<sup>ix</sup> Fatalities per passenger mile: “Comparing the fatality risks in United States transportation across modes and over time,” *The Economics of Transportation Safety*, July 2013. <http://www.sciencedirect.com/science/article/pii/S0739885912002156>

<sup>x</sup> Fatalities per passenger mile: *ibid*; Value of Statistical Life: *ibid*

<sup>xi</sup> Fatalities per passenger mile: *ibid*; Value of Statistical Life: *ibid*

<sup>xii</sup> Fatalities per passenger mile: *ibid*; Value of Statistical Life: *ibid*

<sup>xiii</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.

<sup>xiv</sup> Emissions per mile: “Passenger Train Emissions Factors,” *California Air Resources Board*

Emission cost per mile: “Transportation Cost and Benefit Analysis II – Air Pollution Costs,” *Victoria Transport Policy Institute*, August 2013. <http://www.vtpi.org/tca/tca0510.pdf>

<sup>xv</sup> Emissions per flight: “Calculate your carbon footprint: Individual Air Travel,” Terrapass, <http://www.terrapass.com/carbon-footprint-calculator/>

Emissions cost: “Estimating the Social Cost of Carbon for Use in U.S. Federal Rulemakings: A Summary and Interpretation,” National Bureau of Economic Research, March 2011. <http://www.nber.org/papers/w16913.pdf>

Miles per flight: Google Maps. <https://www.google.com/maps>

<sup>xvi</sup> Emissions cost per mile: “Alternative Approaches to Funding Highways,” *Congressional Budget Office*, March 2011, <http://www.cbo.gov/sites/default/files/03-23-highwayfunding.pdf>

Vehicle occupancy: Congestion Mitigation and Air Quality Project Application, NCDOT, July 2011.

<sup>xvii</sup> Emissions cost per mile: “Cost-Benefit Analysis of Rural and Small Urban Transit,” *Small Urban and Rural Transit Center*, July 2014. <http://www.ugpti.org/resources/reports/downloads/2014-07-cost-benefit-analysis.pdf>

<sup>xviii</sup> Congestion trains alleviate: (1) vehicle miles diverted: CMAQ; (2) Congestion cost per vehicle mile per user: “Transportation Cost and Benefit Analysis II – Congestion Costs,” *Victoria Transport Policy Institute*, August 2013, <http://www.vtpi.org/tca/tca0505.pdf>

<sup>xix</sup> A conservative assumption is used that flights have the equivalent congestion and emissions impacts to trains.

<sup>xx</sup> Congestion cost per mile per user, “Transportation Cost and Benefit Analysis II – Congestion Costs,” *Victoria Transport Policy Institute*, August 2013, <http://www.vtpi.org/tca/tca0505.pdf>

<sup>xxi</sup> “Transportation Cost and Benefit Analysis II – Congestion Costs,” *Victoria Transport Policy Institute*, August 2013, <http://www.vtpi.org/tca/tca0505.pdf>

<sup>xxii</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.

<sup>xxiii</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.

<sup>xxiv</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.

<sup>xxv</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.

<sup>xxvi</sup> Average Ticket Fare: North Carolina Department of Transportation (NCDOT); Portion of trips made: “Piedmont and Carolinian Fall and Spring 2014 On-bard Survey Results,” *Parsons Brinckerhoff*, 2015.